Reference Manual
00809-0100-4860, Rev BC
January 2013

Rosemount 8600D Series Vortex Flowmeter

ROSEMOUNT®

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Process Management

Reference Manual

00809-0100-4860, Rev BC
January 2013

HART
COMMUNICATION PROTOCOL

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Rosemount 8600D
Smart Vortex Flowmeter

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

Within the United States, Rosemount Inc. has two toll-free assistance numbers:

Customer Central
Technical support, quoting, and order-related questions.

1-800-999-9307 (7:00 am to 7:00 pm CST)

North American Response Center
Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of the United States, contact your local Emerson Process Management representative.

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Emerson Process Management Sales Representative.

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Section 1 Introduction

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1.1 How to use this manual

This manual provides installation, configuration, troubleshooting, and other procedures for the use of the Rosemount 8600D Vortex Flowmeter. Specifications and other important information are also included.

Section 2: Installation

Contains mechanical and electrical installation instructions.

Section 3: Configuration

Contains information on entering and verifying basic configuration parameters.

Section 4: Operation

Contains information on advanced configuration parameters and functions that can aid in maintaining the 8600D.

Section 5: Troubleshooting

Provides troubleshooting techniques, diagnostic information, and transmitter verification procedures.

Appendix A: Reference data

Provides reference and specification data.

Appendix B: Approval Information

Provides specific information for approval codes.

Appendix C: Electronics verification

Provides a short procedure for verification of electronic output to assist in meeting the quality standards for ISO 9000 certified manufacturing processes.

Figure 1-1: Rosemount 8600D HART™ Menu Tree

Provides command tree, and Fast Key Sequence tables for the Field Communicator when used in conjunction with the Rosemount 8600D.

1.2 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Refer to the safety messages, listed at the beginning of each section, before performing any operations.

1.3 System description

The Rosemount 8600D Vortex Flowmeter consists of a meter body and transmitter and measures volumetric flow rate by detecting the vortices created by a fluid passing by the shedder bar.

The meter body is installed in-line with process piping. A sensor is located at the end of the shedder bar and creates an alternating sine wave due to the passing vortices. The transmitter measures the frequency of the sine waves and converts it into a flowrate.

This manual is designed to assist in the installation and operation of the Rosemount 8600D Vortex Flowmeter.

⚠ WARNING

This product is intended to be used as a flowmeter for liquid, gas, or steam applications. Any use other than for which it was intended may result in serious injury or death.

Section 2 Installation

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This section provides installation instructions for the Rosemount 8600D Vortex Flowmeter. Dimensional drawings for each Rosemount 8600D variation and mounting configuration are included in the Appendix on page 107.

The options available for the Rosemount 8600D flowmeter are also described in this section. The numbers in parentheses refer to the codes used to order each option.

2.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

⚠ WARNING

Explosions could result in death or serious injury:

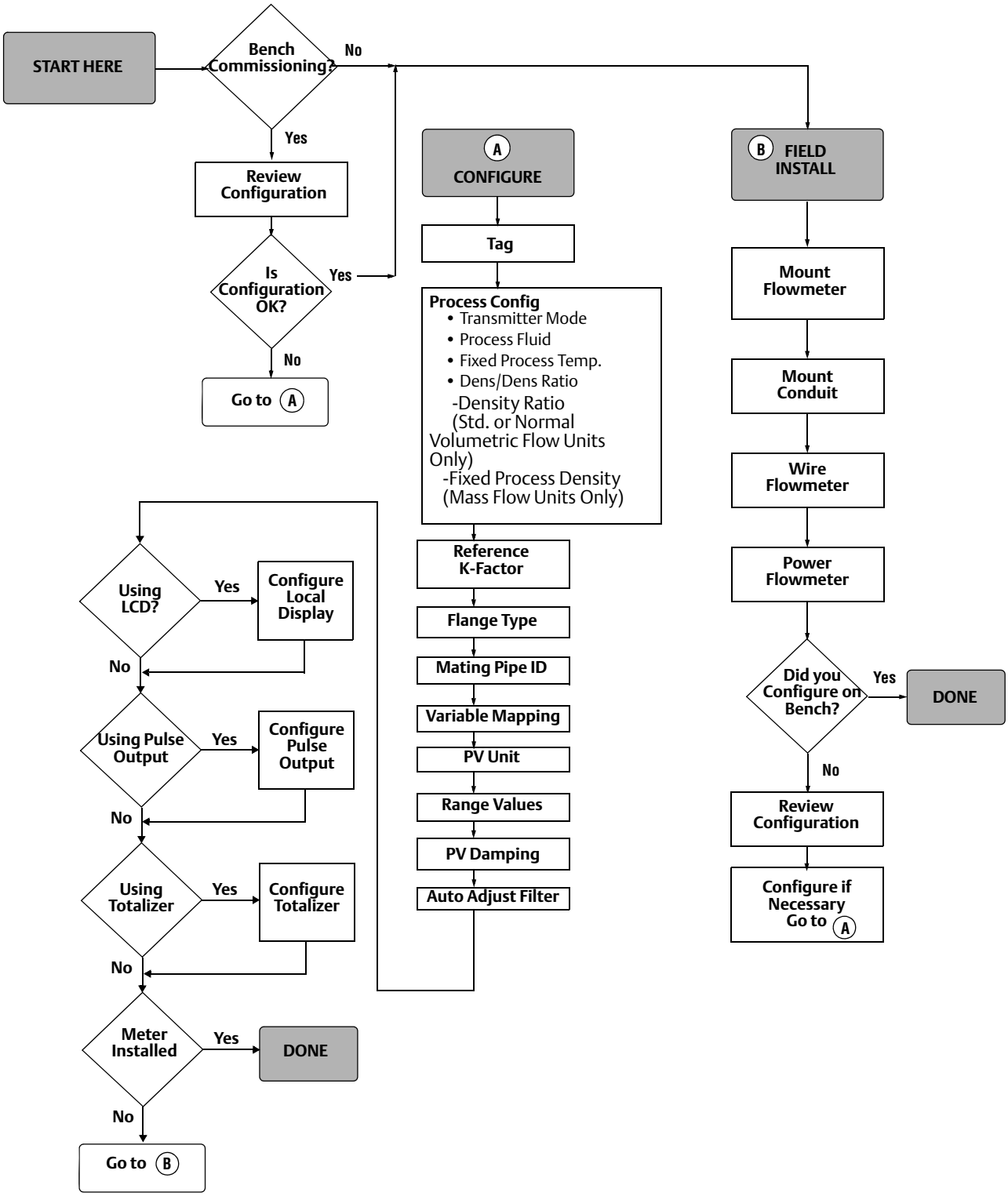
- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

Figure 2-1. Installation Flowchart



2.2 Commissioning

Commission the Rosemount 8600D before putting it into operation. This ensures proper configuration and operation of the meter. It also enables you to check hardware settings, test the flowmeter electronics, verify flowmeter configuration data, and check output variables. Any problems can be corrected – or configuration settings changed – before going out into the installation environment. To commission on the bench, connect the Field Communicator or Asset Management Solutions™ (AMS) software (or other communications device) to the signal loop in accordance with the specifications for your communicator.

2.2.1 General considerations

Before you install a flowmeter in any application, you must consider flowmeter sizing (the line size) and location. Choose the correct flowmeter size for an application to increase rangeability and minimize pressure drop and cavitation. Proper location of the flowmeter can ensure a clean and accurate signal. Follow the installation instructions carefully to reduce start-up delays, ease maintenance, and ensure optimum performance.

2.2.2 Flowmeter sizing

Correct meter sizing is important for flowmeter performance. The Rosemount 8600D is capable of processing signals from flow applications within the limitations described in Appendix A: Reference data. Full scale is continuously adjustable within these ranges.

To determine the correct flowmeter size for an application, process conditions must be within the stated requirements for Reynolds number and velocity. See Appendix A: Reference data for sizing data.

Contact your local Rosemount Inc. sales representative to obtain a copy of Instrument Toolkit® which contains a sizing module for the Rosemount 8600D Vortex flowmeter. The vortex sizing module will calculate valid flowmeter sizes based on user-supplied application information.

2.2.3 Flowmeter orientation

Design process piping so the meter body will remain full, with no entrapped air. Allow enough straight pipe both upstream and downstream of the meter body to ensure a nonskewed, symmetrical profile. Install valves downstream of the meter when possible.

Vertical installation

Vertical installation allows upward process liquid flow and is generally preferred. Upward flow ensures that the meter body always remains full and that any solids in the fluid are evenly distributed.

The vortex meter can be mounted in the vertical down position when measuring gas or steam flows. This type of application should be strongly discouraged for liquid flows, although it can be done with proper piping design.

Note
To ensure that the meter body remains full, avoid downward vertical liquid flows where back pressure is inadequate.

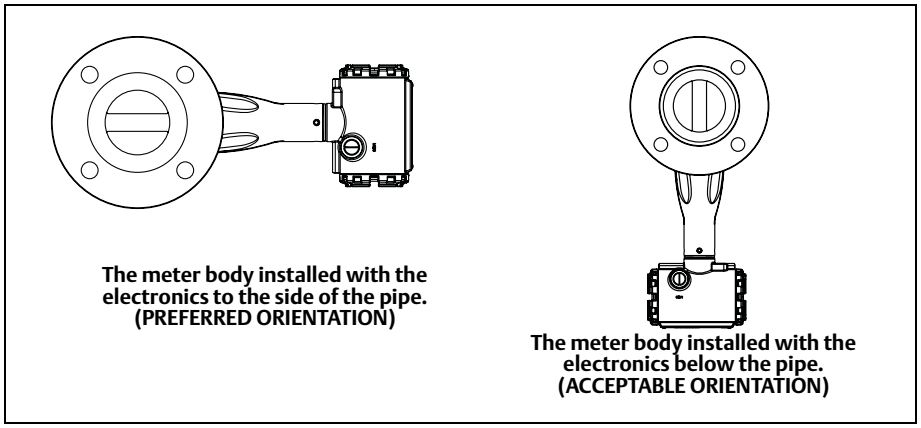
Horizontal installation

For horizontal installation, the preferred orientation is to have the electronics installed to the side of the pipe. In liquid applications, this ensures any entrapped air or solids do not strike the shedding bar and disrupt the shedding frequency. In gas or steam applications, this ensures that any entrained liquid (such as condensate) or solids do not strike the shedder bar and disrupt the shedding frequency.

High-Temperature installations

Install the meter body so the electronics are positioned to the side of the pipe or below the pipe as shown in Figure 2-2. Insulation may be required around the pipe to maintain an electronics temperature below 185 °F (85 °C).

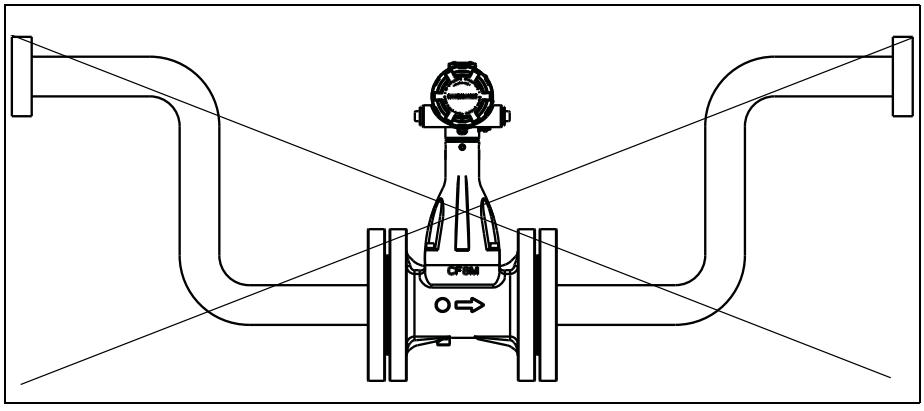
Figure 2-2. Examples of High-Temperature Installations


The meter body installed with the electronics to the side of the pipe. (PREFERRED ORIENTATION)
The meter body installed with the electronics below the pipe. (ACCEPTABLE ORIENTATION)

Steam installations

For steam applications, avoid installations such as the one shown in Figure 2-3. Such installations may cause a water-hammer condition at start-up due to trapped condensate. The high force from the water hammer can over stress the sensing mechanism and cause permanent damage to the sensor.

Figure 2-3. Avoid This Type of Installation for Steam Applications



Upstream/Downstream piping

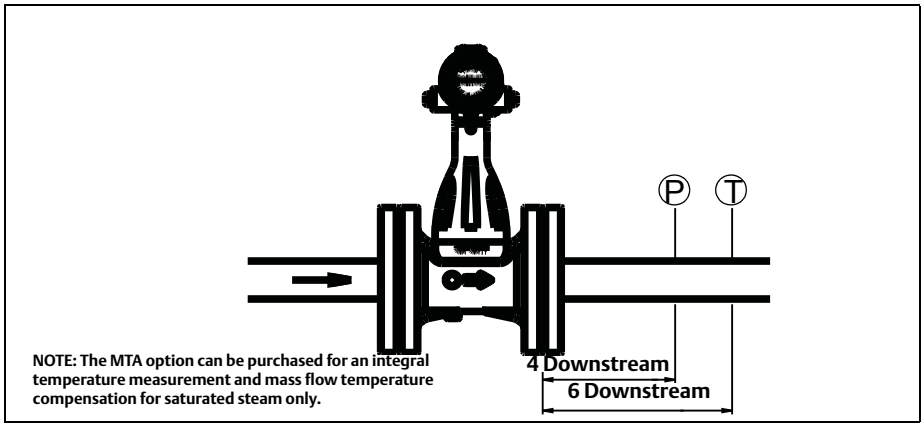
The vortex meter may be installed with a minimum of ten diameters (D) of straight pipe length upstream and five diameters (D) of straight pipe length downstream.

Rated accuracy is based on the number of pipe diameter from an upstream disturbance. No K-factor correction is required if the meter is installed with 35 D upstream and 5 D downstream. The value of the K-factor may shift up to 0.5% when the upstream straight pipe length is between 10D and 35D. Please see Technical Data Sheet (00816-0100-3250) on Installation Effects for optional K-factor corrections. This effect can be corrected for using the Installation Effect Correction Factor (See page 52).

Pressure and temperature transmitter location

When using pressure and temperature transmitters in conjunction with the Rosemount 8600D for compensated mass flows, install the transmitter(s) downstream of the Vortex Flowmeter. See Figure 2-4.

Figure 2-4. Pressure and Temperature Transmitter Location


P
T
4 Downstream
6 Downstream
NOTE: The MTA option can be purchased for an integral temperature measurement and mass flow temperature compensation for saturated steam only.

2.2.4 Wetted material selection

Ensure that the process fluid is compatible with the meter body wetted materials when specifying the Rosemount 8600D. Corrosion will shorten the life of the meter body. Consult recognized sources of corrosion data or contact your Rosemount Sales Representative for more information.

Note
For accurate results perform a Positive Material Identification (PMI) test on a machined surface.

2.2.5 Environmental considerations

Avoid excessive heat and vibration to ensure maximum flowmeter life. Typical problem areas include high-vibration lines with integrally mounted electronics, warm-climate installations in direct sunlight, and outdoor installations in cold climates.

Although the signal conditioning functions reduce susceptibility to extraneous noise, some environments are more suitable than others. Avoid placing the flowmeter or its wiring close to devices that produce high intensity electromagnetic and electrostatic fields. Such devices include electric welding equipment, large electric motors and transformers, and communication transmitters.

2.3 Hazardous locations

The Rosemount 8600D has an explosion-proof housing and circuitry suitable for intrinsically safe and non-incendive operation. Individual transmitters are clearly marked with a tag indicating the certifications they carry.

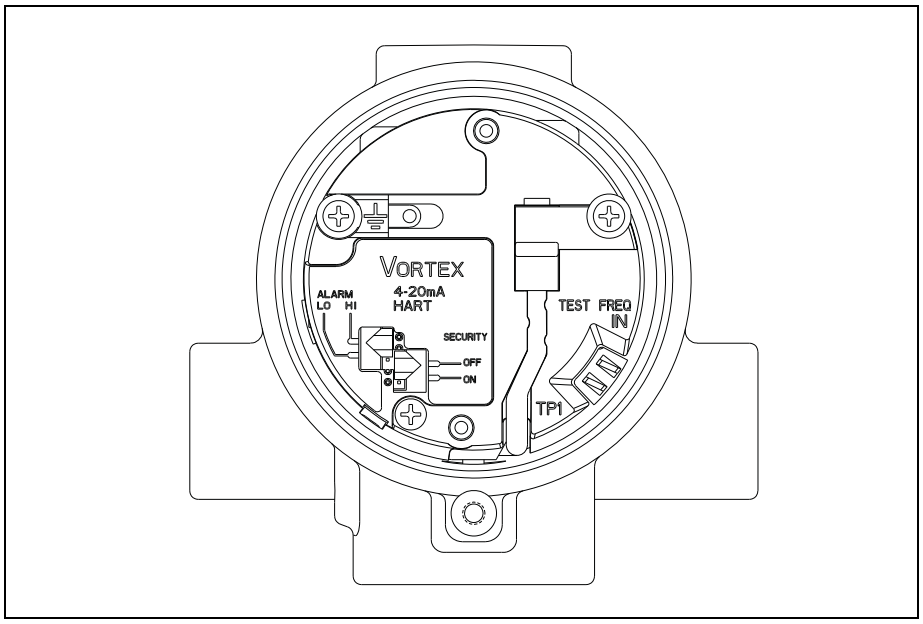
2.4 Hardware configuration

The hardware jumpers on the Rosemount 8600D enable you to set the alarm and security. (See Figure 2-5.) To access the jumpers, remove the electronics housing cover from the electronics end of the Rosemount 8600D. If your Rosemount 8600D includes an LCD option, the alarm and security jumpers are found on the face of the LCD indicator. (See Figure 2-6 on page 10.)

Note
If you will be changing configuration variables frequently, it may be useful to leave the security lockout jumper in the OFF position to avoid exposing the flowmeter electronics to the plant environment.

Set these jumpers during the commissioning stage to avoid exposing the electronics to the plant environment.

Figure 2-5. Alarm and Security Jumpers



Alarm

As part of normal operations, the Rosemount 8600D continuously runs a self-diagnostic routine. If the routine detects an internal failure in the electronics, flowmeter output is driven to a low or high alarm level, depending on the position of the failure mode jumper.

The failure mode jumper is labeled ALARM and is set at the factory per the CDS (Configuration Data Sheet); the default setting is HI.

Security

You can protect the configuration data with the security lockout jumper. With the security lockout jumper ON, any configuration changes attempted on the electronics are disallowed. You can still access and review any of the operating parameters and scroll through the available changes, but no actual changes will be permitted. The security lockout jumper is labeled SECURITY and is set at the factory per the CDS; the default setting is OFF.

2.4.1 Failure mode vs. saturation output values

The failure mode alarm output levels differ from the output values that occur when the operating flow is outside the range points. When the operating flow is outside the range points, the analog output continues to track the operating flow until reaching the saturation value listed below; the output does not exceed the listed saturation value regardless of the operating flow. For example, with standard alarm and saturation levels and flows outside the 4—20 mA range points, the output saturates at 3.9 mA or 20.8 mA. When the transmitter diagnostics detect a failure, the analog output is set to a specific alarm value that differs from the saturation value to allow for proper troubleshooting.

Table 2-1. Analog Output: Standard Alarm Values vs. Saturation Values

Level	4—20 mA Saturation Value	4—20 mA Alarm Value
Low	3.9 mA	≤ 3.75 mA
High	20.8 mA	≥ 21.75 mA

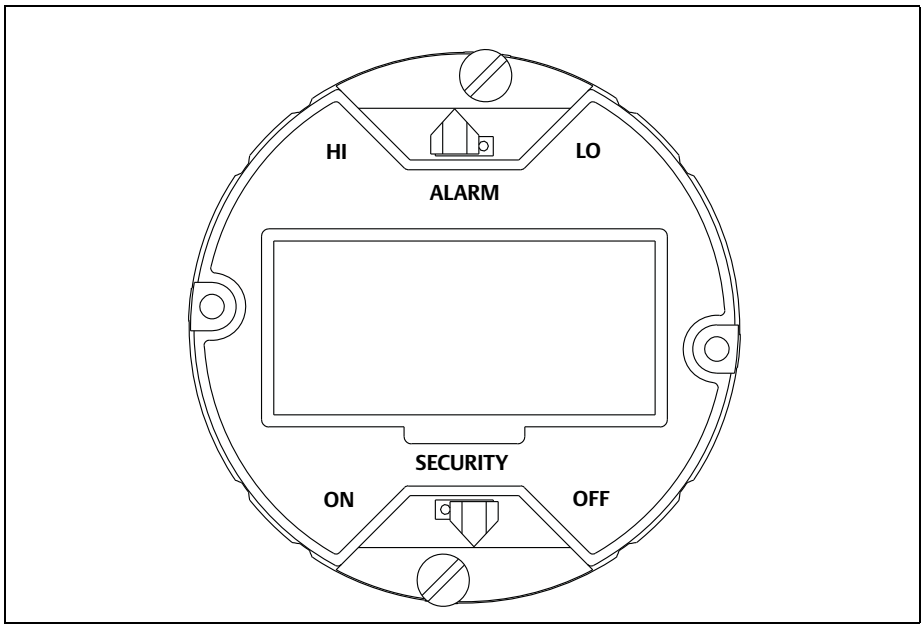
Table 2-2. Analog Output: NAMUR-Compliant Alarm Values vs. Saturation Values

Level	4—20 mA Saturation Value	4—20 mA Alarm Value
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 22.6 mA

2.4.2 LCD indicator option

If your electronics are equipped with the LCD indicator (Option M5), the ALARM and SECURITY jumpers are located on the face of the indicator as shown in Figure 2-6.

Figure 2-6. LCD Indicator Alarm and Security Jumpers



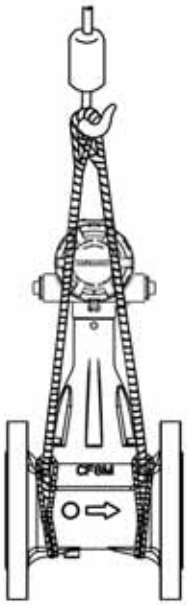
2.5 Meter body installation tasks

The installation tasks include detailed mechanical and electrical installation procedures.

2.5.1 Handling

Handle all parts carefully to prevent damage. Whenever possible, transport the system to the installation site in the original shipping containers. Keep the shipping plugs in the conduit connections until you are ready to connect and seal them.

Note
Do not lift the flowmeter by the transmitter. Lift the meter by the meter body. Lifting supports can be tied around the meter body as illustrated below if necessary.



2.5.2 Flow direction

Mount the meter body so the FORWARD end of the flow arrow, shown on the meter body, points in the direction of the flow in the pipe.

2.5.3 Gaskets

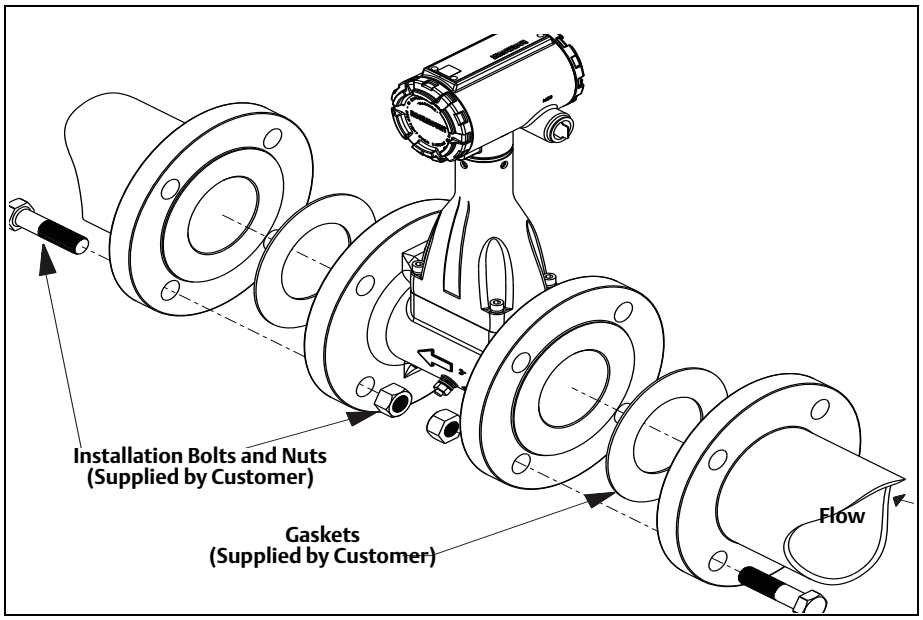
The Rosemount 8600D requires flange gaskets supplied by the user, and sensor gaskets supplied with the meter. Be sure to select gasket material that is compatible with the process fluid and pressure ratings of the specific installation.

Note
Ensure that the inside diameter of the flange gasket is larger than the inside diameter of the flowmeter and adjacent piping. If gasket material extends into the flow stream, it will disturb the flow and cause inaccurate measurements.

2.5.4 Flange bolts

Install the Rosemount 8600D Flowmeter between two conventional pipe flanges, as shown in Figure 2-7 on page 12.

Figure 2-7. Flanged-Style Flowmeter Installation

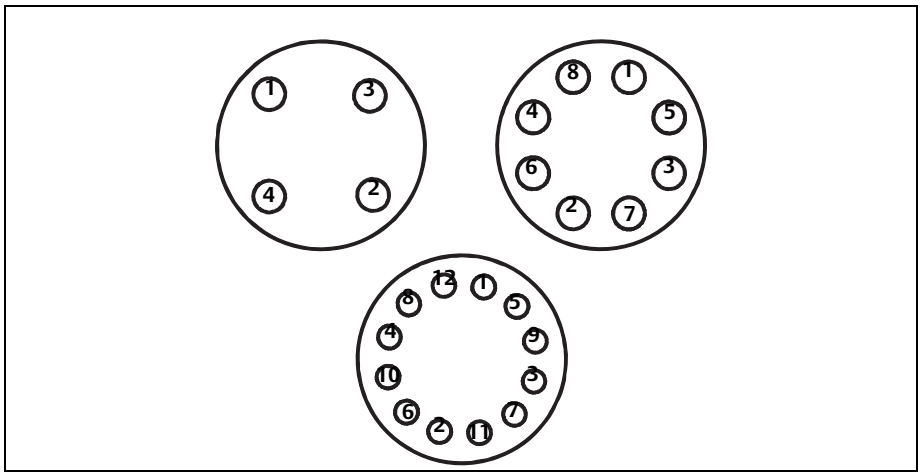


2.5.5 Flanged-style flowmeter mounting

Physical mounting of a flanged-style flowmeter is similar to installing a typical section of pipe. Conventional tools, equipment, and accessories (such as bolts and gaskets) are required. Tighten the nuts following the sequence shown in Figure 2-8.

Note
The required bolt load for sealing the gasket joint is affected by several factors, including operating pressure and gasket material, width, and condition. A number of factors also affect the actual bolt load resulting from a measured torque, including condition of bolt threads, friction between the nut head and the flange, and parallelism of the flanges. Due to these application-dependent factors, the required torque for each application may be different. Follow the guidelines outlined in the ASME Pressure Vessel Code (Section VIII, Division 2) for proper bolt tightening. Make sure the flowmeter is centered between flanges of the same nominal size as the flowmeter.

Figure 2-8. Flange Bolt Torquing Sequence



2.5.6 Flowmeter grounding

Grounding is not required in typical vortex applications; however, a proper ground will eliminate possible noise pickup by the electronics. Grounding straps may be used to ensure that the meter is grounded to the process piping. If you are using the transient protection option (T1), grounding straps are required to provide a proper low impedance ground.

Note
Properly ground flow meter body and transmitter per the local code.

To use grounding straps, secure one end of the grounding strap to the bolt extending from the side of the meter body and attach the other end of each grounding strap to a suitable ground.

2.6 Electronics considerations

Both integral and remote mounted electronics require input power at the electronics. For remote mount installations, mount the electronics
against a flat surface or on a pipe that is up to two inches (50 mm) in diameter.
Remote mounting hardware includes an L bracket that is stainless steel and one stainless steel u-bolt. See Appendix A: Reference data, "Dimensional drawings" on page 107 for dimensional information.

2.6.1 High-Temperature installations

Install the meter body so the electronics are positioned to the side of or
below the pipe as shown in Figure 2-2 on page 6. Insulation may be required around the pipe to maintain an ambient transmitter temperature below 185 °F (85 °C) or the more restrictive temperature ratings marked on hazardous locations tags.

2.6.2 Conduit connections

The electronics housing has two ports for $^1/_2$–14 NPT or M20×1.5 conduit connections. Unless marked otherwise conduit entries in the housing are $^1/_2$ NPT. These connections are made in a conventional manner in accordance with local or plant electrical codes. Be sure to properly seal unused ports to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing. Additional conduit entry types are available via adapters.

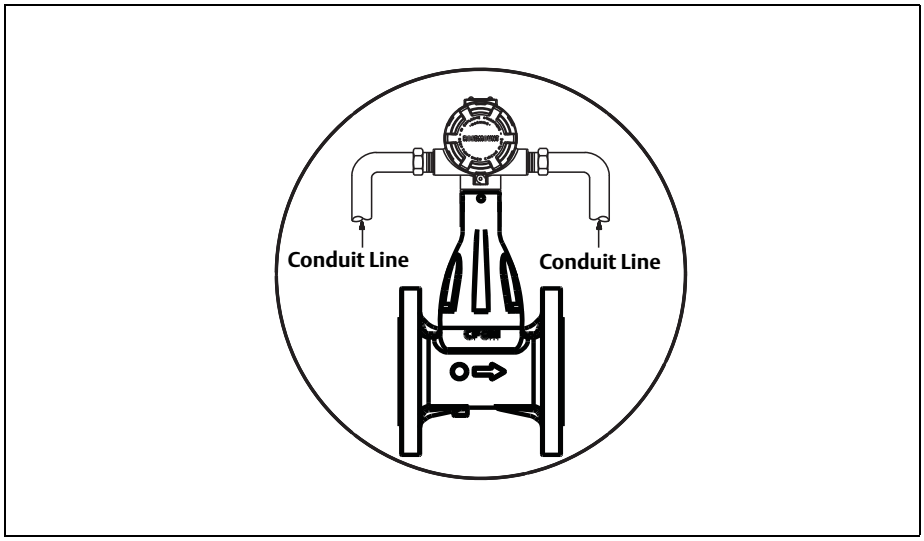
Note
In some applications it may be necessary to install conduit seals and arrange for conduits to drain to prevent moisture from entering the wiring compartment.

2.6.3 High-Point installation

Prevent condensation in any conduit from flowing into the housing by mounting the flowmeter at a high point in the conduit run. If the flowmeter is mounted at a low point in the conduit run, the terminal compartment could fill with fluid.

If the conduit originates above the flowmeter, route conduit below the flowmeter before entry. In some cases a drain seal may need to be installed.

Figure 2-9. Proper Conduit Installation with Rosemount 8600D



2.6.4 Cable gland

If you are using cable glands instead of conduit, follow the cable gland manufacturer's instructions for preparation and make the connections in a conventional manner in accordance with local or plant electrical codes. Be sure to properly seal unused ports to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

2.6.5 Grounding the transmitter case

The transmitter case should always be grounded in accordance with national and local electrical codes. The most effective transmitter case grounding method is direct connection to earth ground with minimal impedance. Methods for grounding the transmitter case include:

- **Internal Ground Connection**: The Internal Ground Connection screw is inside the FIELD TERMINALS side of the electronics housing. This screw is identified by a ground symbol (⏚), and is standard on all Rosemount 8600D transmitters.
- **External Ground Assembly**: This assembly is included with the optional transient protection terminal block (Option Code T1). The External Ground Assembly can also be ordered with the transmitter (Option Code V5) and is automatically included with certain hazardous area approvals.

Note
Grounding the transmitter case using the threaded conduit connection may not provide a sufficient ground. The transient protection terminal block (Option Code T1) does not provide transient protection unless the transmitter case is properly grounded. See "Transient Terminal Block" on page 27 for transient terminal block grounding. Use the above guidelines to ground the transmitter case. Do not run the transient protection ground wire with signal wiring as the ground wire may carry excessive current if a lightning strike occurs.

2.6.6 Wiring procedure

The signal terminals are located in a compartment of the electronics housing separate from the flowmeter electronics. Connections for a HART-based communicator and a current test connection are above the signal terminals. Figure 2-10 illustrates the power supply load limitations for the flowmeter.

Note
A power disconnect is required to remove power from the transmitter for maintenance, removal, and replacement.

Power supply

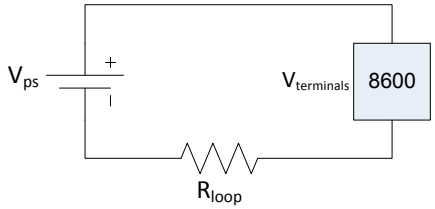
Power Supply Specifications:

Typical installations use a 22 Vdc – 28 Vdc power supply. The dc power supply should provide clean power with less than 2% ripple. Refer to Figure 2-10 as a quick reference.

Loop resistance specification:

If HART communication is required, a minimum resistance of 250□ dc is required between the power supply and the transmitter. *Note: See the *loop load calculation* section to determine the maximum allowable loop resistance as a function of power supply voltage.

Typical single loop wiring diagram:

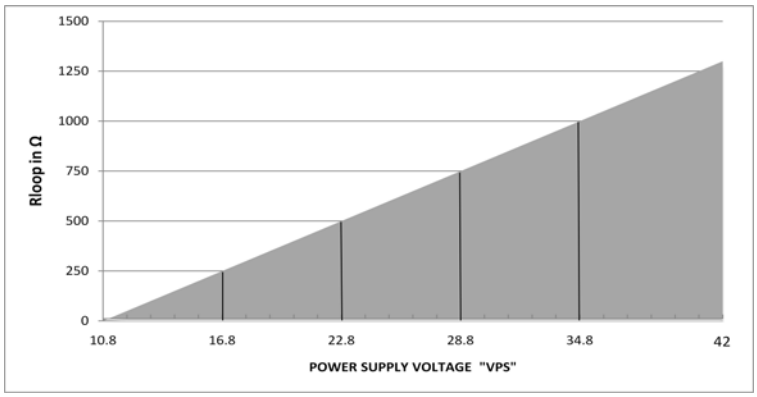


**Loop Load Calculation*: $R_{loop(max)} = (V_{ps} - 10.8) / 0.024$

Where:

- $R_{loop(min)}$ = 250 □. Required for HART communication.
- $R_{loop(max)}$ = The maximum value the loop load resistor can be.
- V_{ps} = Power Supply Voltage
- 10.8 = minimum terminal voltage "$V_{terminals}$" in Vdc.
- 0.024 = maximum transmitter current in Adc

Figure 2-10. Power Supply Load Limitations



Note

$R_{loop(max)}$ in the equation above refers to the total loop load resistance. Technically, the total loop load resistance is the sum of the loop load resistor, signal wiring resistance, and if applicable, any intrinsic safety barriers. In a typical installation, the loop load resistor will largely determine the total loop resistance. In some installations, depending on signal wire gauge and signal wire length, and/or any IS barriers, the additional resistance may need to be accounted for.

To minimize noise pickup on the 4-20 mA signal and any digital communications signal:

- Twisted pair wiring is recommended.
- Shielded signal wire is preferred.
- For high EMI/RFI environments, shielded signal wire is required.

To ensure proper operation, wiring should be:

- 24 AWG or larger.
- Less than 5000 ft. (1500 m) in length.

Gage Number A.W.G.	Ohms per 1,000 ft (305 m) at 68 °F (20 °C) Equivalent
14	2.525
16	4.016
18	6.385
20	10.15
22	16.14
24	25.67

Note

If a Smart Wireless THUM™ Adapter is being used with the Rosemount 8600 flowmeter to exchange information via the *Wireless*HART protocol, an additional 2.5 Vdc is dropped in the connected loop. This is because the THUM is wired in series with the transmitter. Please use the following formula to calculate the maximum loop load resistor.

Loop Load Calculation: $R_{loop(max)} = (V_{ps} – 10.8 – 2.5) / 0.024$

Where:

- $R_{loop(max)}$ = The maximum value the loop load resistor can be.
- V_{ps} = Power Supply Voltage.
- 10.8 = minimum terminal voltage "$V_{terminals}$" in Vdc.
- 2.5 = Maximum voltage drop across the THUM wireless adapter.
- 0.024 = maximum transmitter current in Adc.

Analog output

The flowmeter provides a 4–20 mA dc isolated current output, linear with the flow rate.

To make connections, remove the FIELD TERMINALS side cover of the electronics housing. All power to the electronics is supplied over the 4–20 mA signal wiring. Connect the wires as shown in Figure 2-13 on page 21.

Pulse output

Note
Remember when using the pulse output, all power to the electronics is still supplied over the 4–20 mA signal wiring.

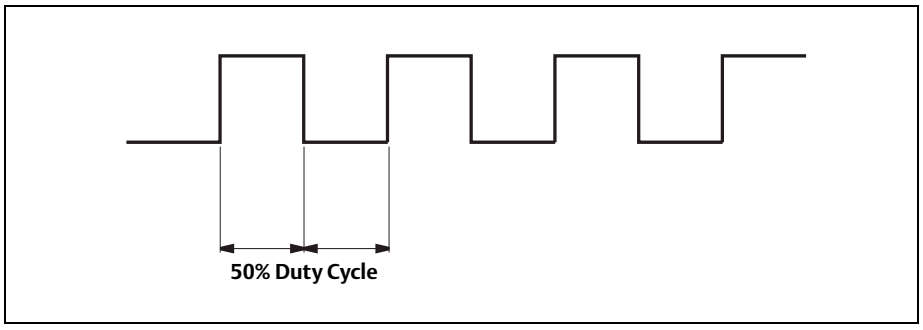
The flowmeter provides an isolated transistor switch-closure frequency output signal proportional to flow, as shown in Figure 2-11. The frequency limits are as follows:

- Maximum Frequency = 10000 Hz
- Minimum Frequency = 0.0000035 Hz (1 pulse/79 hours)
- Duty Cycle = 50%
- External Supply Voltage (V_S): 5 to 30 Vdc
- Load Resistance (R_L): 100 Ω to 100 kΩ
- Max Switching Current = 75 mA >= V_S/R_L
- Switch Closure: Transistor, open collector
  Open contact < 50 μA leakage
  Close contact < 20 Ω

The output may drive an externally powered electromechanical or electronic totalizer, or may serve as a direct input to a control element.

To connect the wires, remove the FIELD TERMINALS side cover of the electronics housing. Connect the wires as shown in Figure 2-14 on page 21.

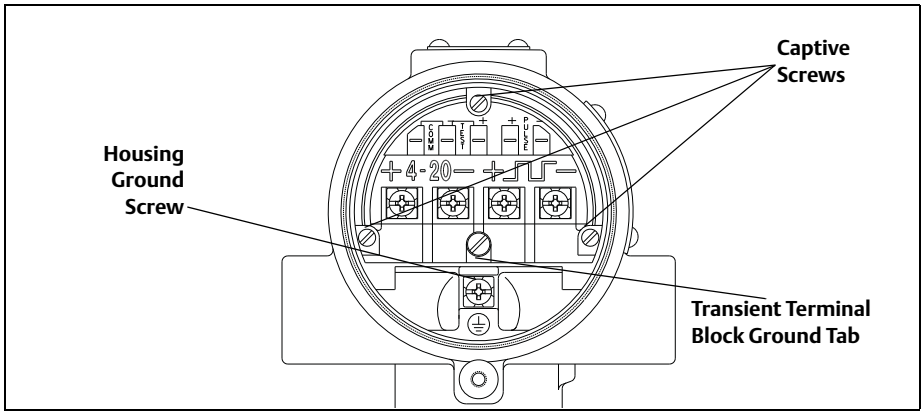
Figure 2-11. Example: The pulse output will maintain a 50 percent duty cycle for all frequencies.



Note
When using pulse output, be sure to follow these precautions:

- Shielded twisted pair is required when the pulse output and 4–20 mA output are run in the same conduit or cable trays. Shielded wire will also reduce false triggering caused by noise pickup. Wiring should be 24 AWG or larger and not exceed 5,000 ft. (1500 m).
- Do not connect the powered signal wiring to the test terminals. Power could damage the test diode in the test connection.
- Do not run signal wiring in conduit or open trays with power wiring or near heavy electrical equipment. If needed, ground signal wiring at any one point on the signal loop, such as the negative terminal of the power supply. The electronics housing is grounded to the meter body.
- If the flowmeter is protected by the optional transient protector, you must provide a high-current ground connection from the electronics housing to earth ground. Also, tighten the ground screw in the bottom center of the terminal block to provide a good ground connection.

Figure 2-12. The Transient Terminal Block



- Plug and seal all unused conduit connections on the electronics housing to avoid moisture accumulation in the terminal side of the housing.
- If the connections are not sealed, mount the flowmeter with the conduit entry positioned downward for drainage. Install wiring with a drip loop, making sure the bottom of the drip loop is lower than the conduit connections or the electronics housing.

Figure 2-13. 4-20 mA Wiring

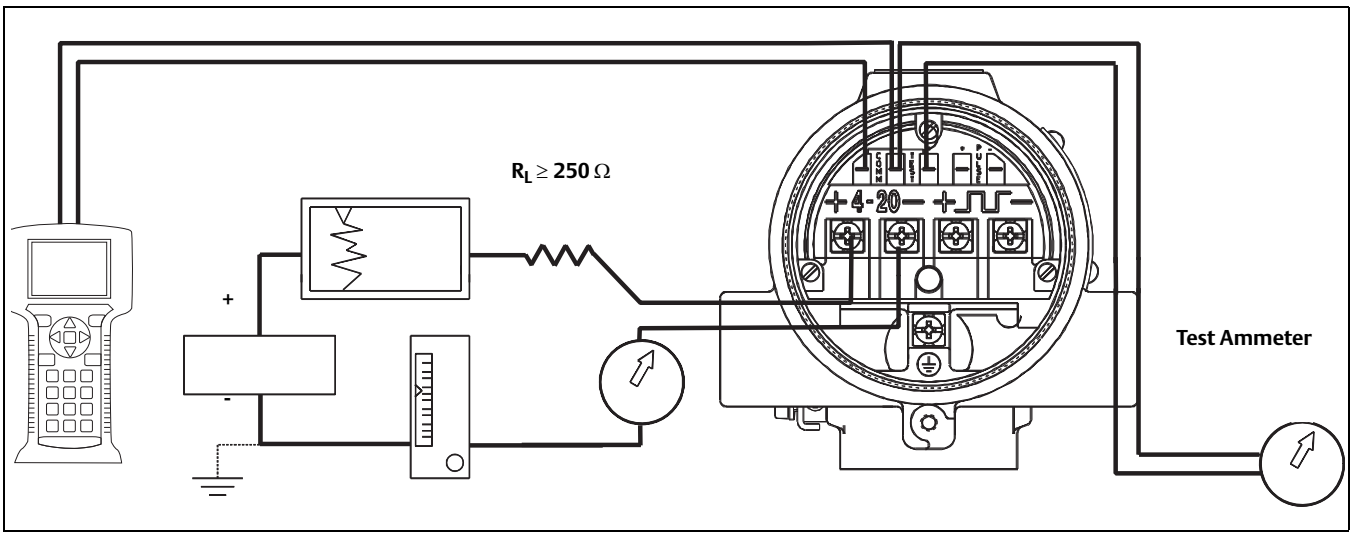
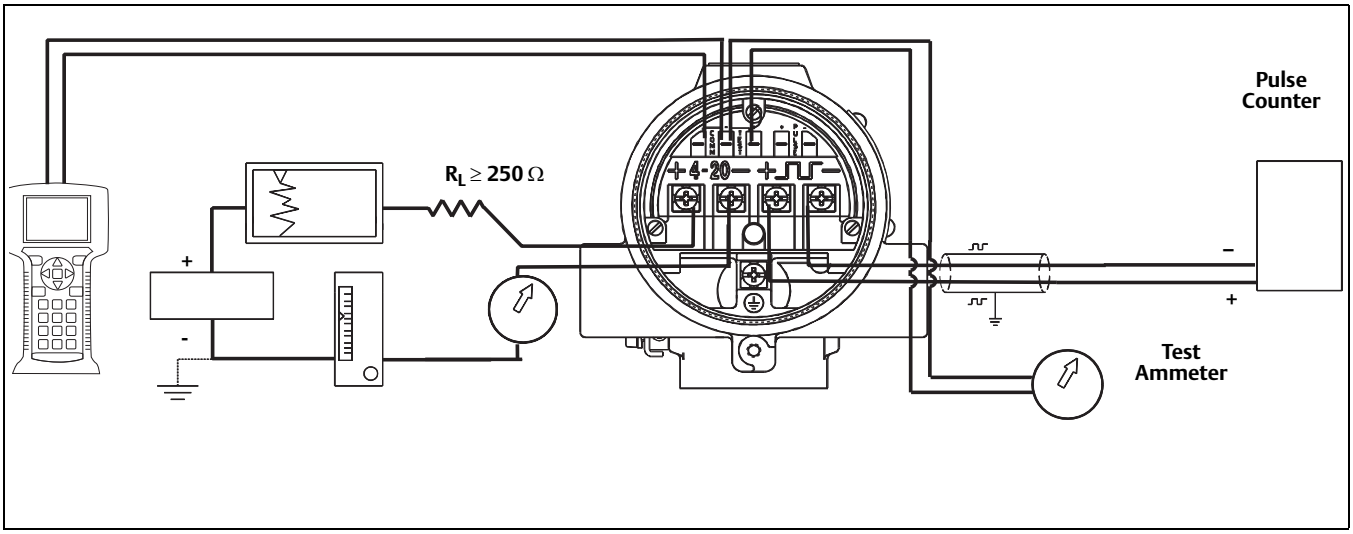


Figure 2-14. 4–20 mA and Pulse Wiring with Electronic Totalizer/ Counter



2.6.7 Remote electronics

If you order one of the remote electronics options (options R10, R20, R30, R33, R50, or RXX), the flowmeter assembly will be shipped in two parts:

1. The meter body with an adapter installed in the bracket and an interconnecting coaxial cable attached to it.

2. The electronics housing installed on a mounting bracket.

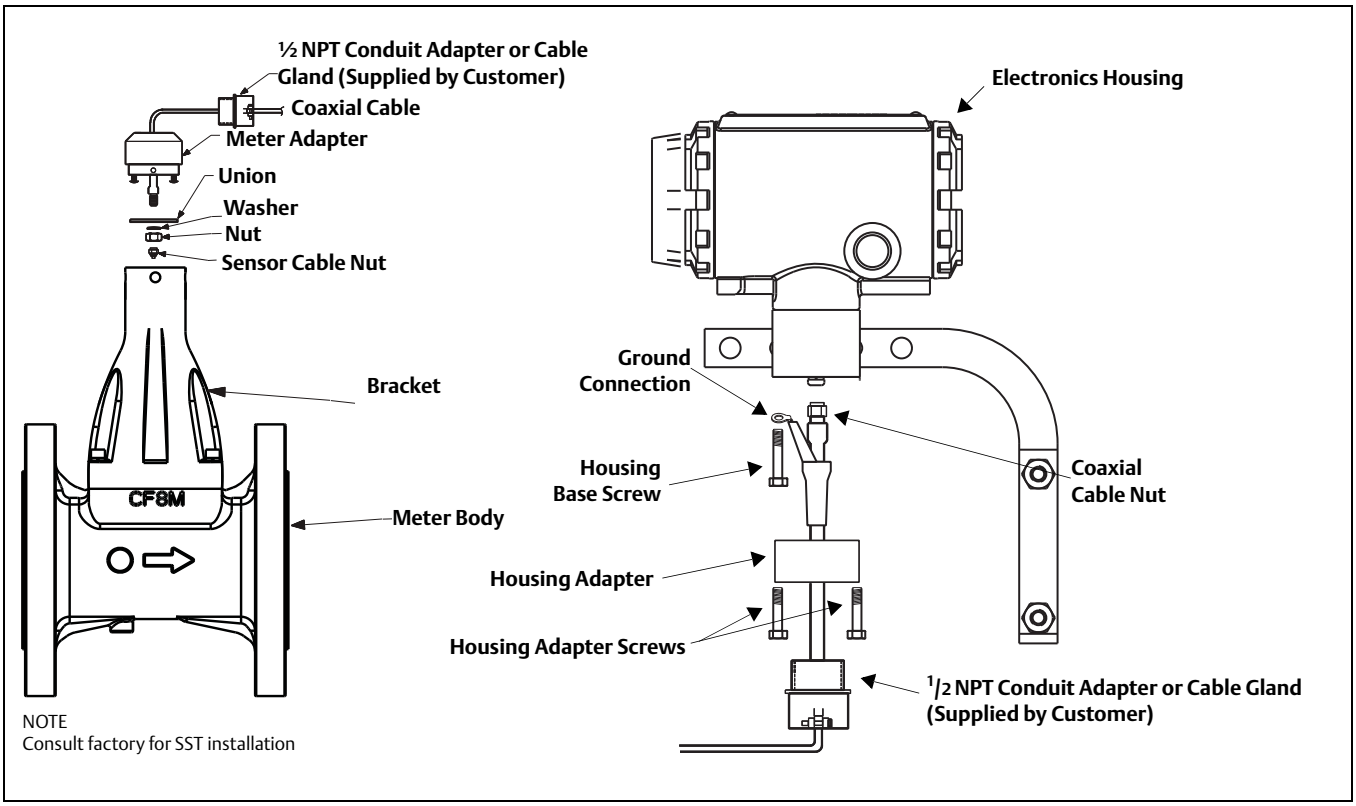
Mounting

Mount the meter body in the process flow line as described earlier in this section. Mount the bracket and electronics housing in the desired location. The housing can be repositioned on the bracket to facilitate field wiring and conduit routing.

Cable connections

Refer to Figure 2-15 and the following instructions to connect the loose end of the coaxial cable to the electronics housing. (See "Remote electronics procedure" on page 83 if connecting/disconnecting the meter adapter to the meter body.)

Figure 2-15. Remote Electronics Installation



1. If you plan to run the coaxial cable in conduit, carefully cut the conduit to the desired length to provide for proper assembly at the housing. A junction box may be placed in the conduit run to provide a space for extra coaxial cable length.
2. Slide the conduit adapter or cable gland over the loose end of the coaxial cable and fasten it to the adapter on the meter body bracket.
3. If using conduit, route the coaxial cable through the conduit.
4. Place a conduit adapter or cable gland over the end of the coaxial cable.
5. Remove the housing adapter from the electronics housing.
6. Slide the housing adapter over the coaxial cable.
7. Remove one of the four housing base screws.
8. Attach the coaxial cable ground wire to the housing via the housing base ground screw.
9. Attach and securely tighten the coaxial cable nut to the connection on the electronics housing.
10. Align the housing adapter with the housing and attach with two screws.
11. Tighten the conduit adapter or cable gland to the housing adapter.

Caution
To prevent moisture from entering the coaxial cable connections, install the interconnecting coaxial cable in a single dedicated conduit run or use sealed cable glands at both ends of the cable.

2.6.8 Calibration

Rosemount 8600D Flowmeters are wet-calibrated at the factory and need no further calibration during installation. The calibration factor (K-factor) is indicated on each meter body and is entered into the electronics. Verification can be accomplished with a Field Communicator or AMS.

2.7 Software configuration

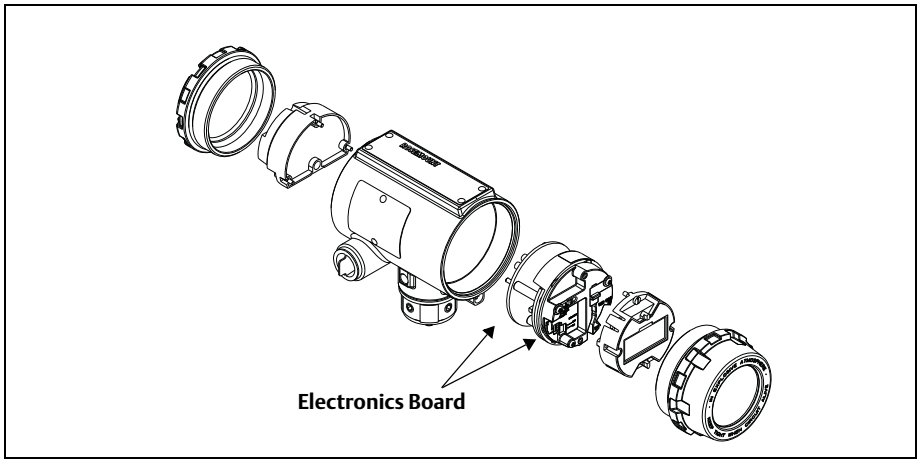
To complete the installation of the Rosemount 8600D Vortex Flowmeter, configure the software to meet the requirements of your application. If the flowmeter was pre-configured at the factory, it may be ready to install. If not, refer to Section 3: Configuration.

LCD indicator

The LCD indicator (option M5) provides local indication of the output and abbreviated diagnostic messages governing operation of the flowmeter. The indicator is located on the electronics side of the flowmeter electronics. An extended cover is required to accommodate

the indicator. Figure 2-16 shows the flowmeter fitted with the LCD indicator and extended cover.

Figure 2-16. Rosemount 8600D with Optional Indicator

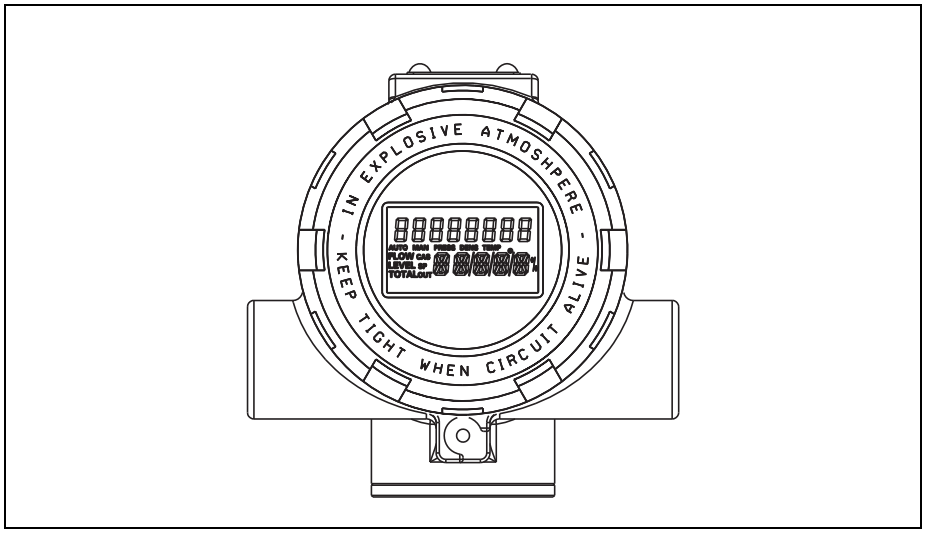


The indicator features an eight-character (and five alphanumeric) liquid crystal display that gives a direct reading of the digital signal from the microprocessor. During normal operation, the display can be configured to alternate between the following readings:

1. Primary variable in engineering units
2. Percent of range
3. Totalized flow
4. 4–20 mA electrical current output
5. Shedding Frequency
6. Electronics Temperature
7. Pulse Output Frequency
8. Process Temperature (MTA Option Only)
9. Mass Flow
10. Volume Flow
11. Velocity Flow
12. Calculated Process Density (MTA Option Only)

Figure 2-17 shows the indicator display with all segments lit.

Figure 2-17. Optional Liquid Crystal Display



A HART-based communicator can be used to change the engineering units of the parameters displayed on the indicator. (SeeSection 4: Operation for more information).

2.7.1 Installing the indicator

For flowmeters ordered with the LCD indicator, the indicator is shipped installed. When purchased separately from the Rosemount 8600D, you must install the indicator using a small instrument screwdriver and the indicator kit (part number 8600-5640). The indicator kit includes:

- One LCD indicator assembly
- One extended cover with o-ring installed
- One connector
- Two mounting screws
- Two jumpers

Referring to Figure 2-16, use the following steps to install the LCD indicator:

1. If the flowmeter is installed in a loop, secure the loop and disconnect the power.
2. Remove the flowmeter cover on the electronics side.

Note
The circuit board is electrostatically sensitive. Be sure to observe handling precautions for static-sensitive components.

3. Insert the mounting screws into the LCD indicator.
4. Remove the two jumpers on the circuit board that coincide with the Alarm and the Security settings.
5. Insert the connector into the Alarm / Security junction.
6. Gently slide the LCD indicator onto the connector and tighten the screws into place.
7. Insert jumpers into ALARM and SECURITY positions on the face of the LCD indicator.
8. Attach the extended cover and tighten at least one-third turn past o-ring contact.

Note
The indicator may be installed in 90-degree increments for easy viewing. Mounting screws may need to be installed in the alternative holes based on LCD orientation. One of the four connectors on the back of the indicator assembly must be positioned to fit into the ten-pin connector on the electronic board stack.

Note the following LCD temperature limits:

Operating:	–4 to 185 °F	(–20 to 85 °C)
Storage:	–50 to 185 °F	(–46 to 85 °C)

2.8 Transient protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

The transient terminal block meets the following specifications:

IEEE C62.41 - 2002 Category B.

3 kA crest (8 X 20 μs)

6 kV crest (1.2 X 50 μs)

6 kV/0.5 kA (0.5 μs, 100 kHz, ring wave)

Note
The ground screw inside the terminal housing must be tightened for the proper operation of the transient protection. Also, a high-current ground connection to earth is required.

2.8.1 Installing the Transient Protector

For flowmeters ordered with the transient protector option (T1), the protector is shipped installed. When purchased separately from the Rosemount 8600D, you must install the protector on a Rosemount 8600D flowmeter using a small instrument screwdriver, a pliers, and the transient protection kit.

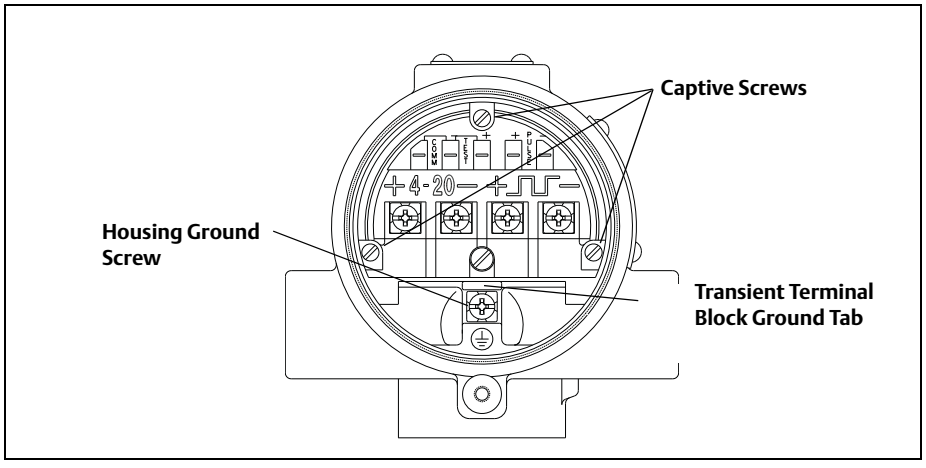
The transient protection kit includes the following:

- One transient protection terminal block assembly
- Three captive screws

Use the following steps to install the transient protector:

1. If the flowmeter is installed in a loop, secure the loop and disconnect power.
2. Remove the field terminal side flowmeter cover.
3. Remove the captive screws.
4. Remove the housing ground screw.
5. Use pliers to pull the terminal block out of the housing.
6. Inspect the connector pins for straightness.
7. Place the new terminal block in position and carefully press it into place. The terminal block may have to be moved back and forth to get the connector pins started into the sockets.
8. Tighten the captive screws.
9. Install and tighten the ground screw.
10. Replace the cover.

Figure 2-18. Transient Terminal Block



Section 3 Configuration

Review . . . . . **page 29**
Process variables . . . . . **page 29**
Basic setup . . . . . **page 37**

3.1 Review

Field Comm.	1, 5

Review the flowmeter configuration parameters set at the factory to ensure accuracy and compatibility with your particular application of the flowmeter. Once you have activated the Review function, scroll through the data list to check each variable in the configuration data list.

The last step of start-up and commissioning is to check the flowmeter output to ensure that the flowmeter is operating properly. Rosemount 8600D digital process variables include: primary variable, primary variable as a percent of range, analog output, vortex shedding rate, pulse frequency, mass flow, volumetric flow, velocity flow, totalizer, electronics temperature, calculated process density, cold junction temperature, and process temperature.

3.2 Process variables

Field Comm.	1, 1

The process variables for the Rosemount 8600D provide the flowmeter output. When commissioning a flowmeter, review each process variable, its function and output, and take corrective action if necessary before using the flowmeter in a process application.

3.2.1 Primary Variable (PV)

Field Comm.	1, 1, 1

PV – The measured value of the variable mapped to the primary variable. This can be either Process Temperature (MTA option only) or Flow. Flow variables are available as mass, volume, or velocity. When bench commissioning, the flow values for each variable should be zero and the temperature value should be the ambient temperature.

If the units for the flow or temperature variables are not correct, refer to "View other variables" on page 30. Use the Process Variable Units function to select the units for your application.

3.2.2 PV% of range

Field Comm.	1, 1, 2

Percent of Range — The primary variable as a percentage of range provides a gauge as to where the current measurement of the meter is within the configured range of the meter. For example, the range may be defined as 0 gal/min to 20 gal/min. If the current flow is 10 gal/min, the percent of range is 50 percent.

3.2.3 Analog output

Field Comm.	1, 1, 3

Analog Output — The analog output variable provides the analog value for the primary variable. The analog output refers to the industry standard output in the 4–20 mA range. Check the analog output value against the actual loop reading given by a multi-meter. If it does not match, a 4–20 mA trim is required. See D/A Trim (Digital-to-Analog Trim).

3.2.4 View other variables

Field Comm.	1, 1, 4

View Other Variables — Allows for the viewing and configuration of other variables such as flow units, totalizer operation, and pulse output.

Volume flow

Field Comm.	1, 1, 4, 1, 1

Allows the user to view the current volumetric flow value.

Volume flow units

Field Comm.	1, 1, 4, 1, 2

Allows the user to select the volumetric flow units from the available list.

Volumetric Unit	LCD Display	Field Communicator
U.S. Gallons per second	GAL/S	gal/s
U.S. Gallons per minute	GAL/M	gal/m
U.S. Gallons per hour	GAL/H	gal/h
U.S. Gallons per day	GAL/D	gal/d
Actual Cubic Feet per second	ACFS	ACFS
Actual Cubic Feet per minute	ACFM	ACFM
Actual Cubic Feet per hour	ACFH	ACFH
Actual Cubic Feet per day	ACFD	ACFD
Standard Cubic Feet per minute	SCFM	
Standard Cubic Feet per hour	SCFH	
Barrels per second	BBL/S	bbl/s
Barrels per minute	BBL/M	bbl/min
Barrels per hour	BBL/H	bbl/h

Barrels per day	BBL/D	bbl/d
Imperial Gallons per second	IGAL/S	Impgal/s
Imperial Gallons per minute	IGAL/M	Impgal/min
Imperial Gallons per hour	IGAL/H	Impgal/h
Imperial Gallons per day	IGAL/D	Impgal/d
Liters per second	L/S	L/s
Liters per minute	L/MIN	L/min
Liters per hour	L/H	L/h
Liters per day	L/D	L/D
Actual Cubic Meters per second	ACMS	ACMS
Actual Cubic Meters per minute	ACMM	ACMM
Actual Cubic Meters per hour	ACMH	ACMH
Actual Cubic Meters per day	ACMD	ACMD
Million Actual Cubic Meters per day	MACMD	MACMD
Normal Cubic Meters per minute	NCMM	
Normal Cubic Meters per hour	NCMH	
Normal Cubic Meters per day	NCMD	

Standard/Normal flow units

StdCuft/min

SCFH

NCMM

NmlCum/h

NCMD

Note
When configuring Standard or Normal Flow units to the volumetric flow, a density ratio must be provided. See the Density/Density Ratio on page 39.

Special units

Field Comm.	1, 1, 4, 1, 3

Special Units allows you to create flow rate units that are not among the standard options. They can be volumetric only. Configuration of a special unit involves entry of these values: base volume unit, base time unit, user defined unit and conversion number. Suppose you want the

Rosemount 8600D to display flow in barrels per minute instead of gallons per minute, and one barrel is equal to 31.0 gallons.

- Base volume unit: gal
- Base time unit: min
- User defined unit: br
- Conversion number: $^{1}/_{31.0}$

See the specific variables listed below for more information on setting special units.

Base volume unit

Field Comm.	1, 1, 4, 1, 3, 1

Base Volume Unit is the unit from which the conversion is made. You must select one of the Field Communicator defined unit options:

- Gallons (gal)
- Liters (L)
- Imperial gallons (Impgal)
- Cubic meters (Cum)
- Barrels (bbl) where 1 bbl=42 gal
- Cubic Feet (Cuft)

Base time unit

Field Comm.	1, 1, 4, 1, 3, 2

Base Time Unit provides the time unit from which to calculate the special units. For example, if your special units is a volume per minute, select minutes. Choose from the following units:

- Seconds (s)
- Minutes (min)
- Hours (h)
- Days (d)

User defined unit

Field Comm.	1, 1, 4, 1, 3, 3

User Defined Unit is a format variable that provides a record of the flow units to which you are converting. The LCD on the Rosemount 8600D will display the actual units you define. The Field Communicator will simply display “SPCL.” There are four characters available to store the new units designation.

Conversion number

Field Comm.	1, 1, 4, 1, 3, 4

Conversion Number is used to relate base units to special units. For a straight conversion of volume units from one to another, the conversion number is the number of base units in the new unit.

For example, if you are converting from gallons to barrels and there are 31 gallons in a barrel, the conversion factor is 31. The conversion equation is as follows (where barrels is the new volume unit):

1 gallon = 0.032258 bbl.

Mass flow

Field Comm.	1, 1, 4, 2

Allows the user to view the current mass flow value and units. Also allows the user to configure the mass flow units.

Mass flow

Field Comm.	1, 1, 4, 2, 1

Displays the current mass flow value and units.

Mass units

Field Comm.	1, 1, 4, 2, 2

Allows the user to select the mass flow units from the available list. (1 STon = 2000 lb; 1 MetTon = 1000 kg)

Mass Flow Units

lb/s	STon/min
lb/min	STon/h
lb/h	STon/d
lb/d	MetTon/min
kg/s	MetTon/h
kg/min	MetTon/d
kg/h	g/s
kg/d	g/min
	g/h

Note
If you select a Mass Units option, you must enter process density in your configuration. See the Density/Density Ratio section on page 39.

Velocity flow

Field Comm.	1, 1, 4, 3

Allows the user to view the current velocity flow value and units. Also allows the user to configure the velocity flow units.

Velocity flow

Field Comm.	1, 1, 4, 3, 1

Displays the current velocity flow value and units.

Velocity units

Field Comm.	1, 1, 4, 3, 2

Allows the user to select the velocity units from the available list.

ft/s
m/s

Velocity measured base

Field Comm.	1, 1, 4, 3, 3

Velocity Measured Base will determine if the velocity measurement is based on the mating pipe ID or the meter body ID.

Totalizer

Field Comm.	1, 1, 4, 4

Totalizer — Totalizer tallies the total amount of liquid or gas that has passed through the flowmeter since the totalizer was last reset.

It enables you to change the settings of the totalizer.

Total

Field Comm.	1, 1, 4, 4, 1

Total — Provides the output reading of the totalizer. Its value is the amount of liquid or gas that has passed through the flowmeter since the totalizer was last reset.

Start

Field Comm.	1, 1, 4, 4, 2

Start — Starts the totalizer counting from its current value.

Stop

Field Comm.	1, 1, 4, 4, 3

Stop — Interrupts the totalizer count until it is restarted again. This feature is often used during pipe cleaning or other maintenance operations.

Reset

Field Comm.	1, 1, 4, 4, 4

Reset — Returns the totalizer value to zero. If the totalizer was running, it will continue to run starting at zero.

Totalizer config

Field Comm.	1, 1, 4, 4, 5

Totalizer Config — Used to configure the flow parameter (volume, mass, velocity) that will be totalled.

Note
The totalizer value is saved in the non-volatile memory of the electronics every three seconds. Should power to the transmitter be interrupted, the totalizer value will start at the last saved value when the power is re-applied.

Note
Changes that affect the density, density ratio, or compensated K-Factor will affect the totalizer value being calculated. These changes will not cause the existing totalizer value to be recalculated.

Pulse frequency

Field Comm.	1, 1, 4, 5

Allows users to view the pulse output frequency value. To configure the pulse output, refer to the section on pulse output found on page 54.

Vortex frequency

Field Comm.	1, 1, 4, 6

Allows users to view the shedding frequency directly off of the sensor.

Electronics temperature

Field Comm.	1, 1, 4, 7

Allows users to view the electronics temperature value and units. Also allows the user to configure the units for the electronics temperature.

Electronics temperature

Field Comm.	1, 1, 4, 7, 1

Displays the current electronics temperature value and units.

Electronics temperature unit

Field Comm.	1, 1, 4, 7, 2

Allows the user to select the units for electronics temperature from the available list.

deg C
deg F
deg R
Kelvin

Calculated process density

Field Comm.	1, 1, 4, 8

Allows users to view the calculated process density value when the vortex is configured for temperature compensated steam applications. Also allows the user to configure the calculated density units.

Process density

Field Comm.	1, 1, 4, 8, 1

Displays the current calculated process density value.

Density units

Field Comm.	1, 1, 4, 8, 2

Allows the user to configure the units for the calculated process density from the available list.

g/Cucm (cm^3)
g/L
kg/Cum (m^3)
lb/Cuft (ft^3)
lb/Cuin (in^3)

Process temperature

Field Comm.	1, 1, 4, 9

Allows users to view the process temperature value when the vortex transmitter has the temperature sensor option. Also allows the user to configure the process temperature units.

Process temperature

Field Comm.	1, 1, 4, 9, 1

Displays the current process temperature value.

Process temperature units

Field Comm.	1, 1, 4, 9, 2

Allows the user to configure the units for the process temperature from the available list.

deg C
deg F
deg R
Kelvin

T/C failure mode

Field Comm.	1, 1, 4, 9, 3

Allows the user to configure the temperature sensor failure mode. In the event that the thermocouple sensor fails, the vortex can go either into an alarm output mode, or continue to operate normally using the Fixed Process Temperature value. See Fixed Process Temperature page 38. This mode is only relevant with the MTA option.

Note
If the Primary Variable is set to Process Temperature and there is an error, the output will always go to alarm and this setting will be ignored.

Cold Junction (CJ) temperature

Field Comm.	1, 1, 4, Scroll to bottom of list

Allows users to view the thermocouple cold junction temperature value when the vortex has the temperature sensor option. Also allows the user to configure the CJ temperature units.

CJ temperature

Field Comm.	1, 1, 4, -, 1

Displays the current thermocouple cold junction temperature value.

CJ temperature units

Field Comm.	1, 1, 4, -, 2

Allows the user to configure the units for the thermocouple cold junction temperature from the available list.

deg C
deg F
deg R
Kelvin

3.2.5 Basic setup

Field Comm.	1, 3

The Rosemount 8600D must be configured for certain basic variables in order to be operational. In most cases, all of these variables are pre-configured at the factory. Configuration may be required if your Rosemount 8600D is not configured or if the configuration variables need revision.

3.2.6 Tag

Field Comm.	1, 3, 1

Tag is the quickest way to identify and distinguish between flowmeters. Flowmeters can be tagged according to the requirements of your application. The tag may be up to eight characters long.

3.2.7 Process config

Field Comm.	1, 3, 2

The flowmeter can be used for liquid or gas/steam applications, but it must be configured specifically for the application. If the flowmeter is not configured for the proper process, readings will be inaccurate. Select the appropriate Process configuration parameters for your application:

Transmitter mode

Field Comm.	1, 3, 2, 1

For units with an integral temperature sensor, the temperature sensor can be activated here.

Without Temperature Sensor
With Temperature Sensor

Process fluid

Field Comm.	1, 3, 2, 2

Select the fluid type: either Liquid, Gas/Steam, Tcomp Sat Steam. Tcomp Sat Steam requires the MTA Option and provides a temperature compensated mass flow output for saturated steam.

Fixed process temperature

Field Comm.	1, 3, 2, 3

Process Temperature is needed for the electronics to compensate for thermal expansion of the flowmeter as the process temperature differs from the reference temperature. Process temperature is the temperature of the liquid or gas in the line during flowmeter operation.

Fixed process temperature may also be used as a back-up temperature value in the event of a temperature sensor failure if the MTA option is installed.

Note
The Fixed Process Temperature may also be changed under Calculate Density Ratio.

Density/Density ratio

Field Comm.	1, 3, 2, 4

When configuring a meter for mass flow units, a density value needs to be entered. When configuring a meter for Standard and Normal Volumetric flow units a density ratio will be required.

Density ratio

Field Comm.	1, 3, 2, 4, 1

Configure the Density Ratio in one of two ways:

1. Enter Density Ratio to convert from actual flow rate to standard flow rate.
2. Enter the process and base conditions. (The Rosemount 8600D electronics will then calculate the density ratio for you).

Note
Be careful to calculate and enter the correct conversion factor. Standard flow is calculated with the conversion factor you enter. Any error in the factor entered will result in an error in the standard flow measurement. If pressure and temperature changes over time, use actual volumetric flow units. The Rosemount 8600D does not compensate for changing temperature and pressure.

Note
Changing the base process conditions will modify the density ratio. Likewise a change to the density ratio will lead to a change in the base process pressure (Pf).

Density ratio

Field Comm.	1, 3, 2, 4, 1, 1

Density Ratio is used to convert actual volumetric flow to standard volumetric flow rates based on the following equations:

$$\text{DensityRatio} = \frac{\text{density at actual (flowing) conditions}}{\text{density at standard (base) conditions}}$$

$$\text{DensityRatio} = \frac{T_b \times P_f \times Z_b}{T_f \times P_b \times Z_f}$$

Calculate density ratio

Field Comm.	1, 3, 2, 4, 1, 2

Calculate Density Ratio will calculate the density ratio (shown above) based on user entered process and base conditions.

Operating conditions

Field Comm.	1, 3, 2, 4, 1, 2, 1

T_f = absolute temperature at actual (flowing) conditions in degrees Rankine or Kelvin. (The transmitter will convert from degrees Fahrenheit or degrees Celsius to degrees Rankine or Kelvin respectively.)

P_f = absolute pressure at actual (flowing) conditions psia or KPa absolute. (The transmitter will convert from psi, bar, kg/sqcm, kpa, or mpa to psi or kpa for calculation. Note that pressure values must be absolute.)

Z_f = compressibility at actual (flowing) conditions (dimensionless)

Base conditions

Field Comm.	1, 3, 2, 4, 1, 2, 2

T_b = absolute temperature at standard (base) conditions degrees Rankine or Kelvin. (The transmitter will convert from degrees Fahrenheit or degrees Celsius to degrees Rankine or Kelvin respectively.)

P_b = absolute pressure at standard (base) conditions psia or KPa absolute. (The transmitter will convert from psi, bar, kg/sqcm, kpa, or mpa to psi or kpa for calculation. Note that pressure values must be absolute.)

Z_b = compressibility at standard (base) conditions (dimensionless)

Example

Configure the Rosemount 8600D to display flow in standard cubic feet per minute (SCFM). (Fluid is hydrogen flowing at conditions of 170 °F and 100 psia.) Assume base conditions of 59 °F and 14.696 psia.)

$$\text{DensityRatio} = \frac{518.57\ ^\circ\text{R} \times 100\ \text{psia} \times 1.0006}{629.67\ ^\circ\text{R} \times 14.7\ \text{psia} \times 1.0036} = 5.586$$

Fixed process density

Field Comm.	1, 3, 2, 4, 2

Process Density is required only if you have designated mass units for your flow rate units. You will first be prompted for density units. It is required for the conversion from volumetric units to mass units. For example, if you have set flow units to kg/sec rather than gal/sec, a density is required to convert the measured volumetric flow into the desired mass flow. The Fixed Process Density must be entered even in temperature compensated Saturated Steam applications as this value is used to determine flow sensor limits in Mass Flow Units.

Note
If mass units are chosen, you must enter the density of your process fluid into the software. Be careful to enter the correct density. The mass flow rate is calculated using this user-entered density, and any error in this number will cause error in the mass flow measurement. If fluid density is changing over time, it is recommended that volumetric flow units be used.

3.2.8 Reference K-factor

Field Comm.	1, 3, 3

The reference K-factor is a factory calibration number relating the flow through the meter to the shedding frequency measured by the electronics. Every 8600 meter manufactured by Emerson is run through a water calibration to determine this value.

3.2.9 Flange type

Field Comm.	1, 3, 4

Flange Type enables you to specify the type of flange on the flowmeter for later reference. This variable is preset at the factory but can be changed if necessary.

- ANSI 150
- ANSI 300
- PN16
- PN40
- Spcl

3.2.10 Mating pipe ID (Inside Diameter)

Field Comm.	1, 3, 5

The Pipe ID (Inside Diameter) of the pipe adjacent to the flowmeter can cause entrance effects that may alter flowmeter readings. You must specify the exact inside diameter of the pipe to correct for these effects. Enter the appropriate value for this variable.

Pipe ID values for schedule 10, 40, and 80 piping are given in Table 3-1. If the piping in your application is not one of these, you may need to contact the manufacturer for exact Pipe ID.

Table 3-1. Pipe IDs for Schedule 10, 40, and 80 Piping

Pipe Size Inches (mm)	Schedule 10 Inches (mm)	Schedule 40 Inches (mm)	Schedule 80 Inches (mm)
1 (25)	1.097 (27.86)	1.049 (26.64)	0.957 (24.31)
1½ (40)	1.682 (42.72)	1.610 (40.89)	1.500 (38.10)
2 (50)	2.157 (54.79)	2.067 (52.50)	1.939 (49.25)
3 (80)	3.260 (82.80)	3.068 (77.93)	2.900 (73.66)
4 (100)	4.260 (108.2)	4.026 (102.3)	3.826 (97.18)
6 (150)	6.357 (161.5)	6.065 (154.1)	5.716 (145.2)
8 (200)	8.329 (211.6)	7.981 (202.7)	7.625 (193.7)

3.2.11 Variable mapping

Field Comm.	1, 3, 6

Allows the user to select which Variables the 8600D will output.

Primary Variable (PV)

Field Comm.	1, 3, 6, 1

Selections for this Variable are Mass Flow, Volumetric Flow, Velocity Flow, and Process Temperature. The Primary Variable is the variable mapped to the analog output.

Secondary Variable (SV)

Field Comm.	1, 3, 6, 2

Selections for this Variable include all Variables that can be mapped to PV, and also Vortex Frequency, Pulse Output Frequency, Totalizer Value, Calculated Process Density, Electronics Temperature, and Cold Junction (CJ) Temperature.

Tertiary Variable (TV)

Field Comm.	1, 3, 6, 3

Selections for this Variable are identical to those of the Secondary Variable.

Quaternary Variable (4V)

Field Comm.	1, 3, 6, 4

Selections for this Variable are identical to those of the Secondary Variable.

3.2.12 PV units

Field Comm.	1, 3, 7

Selections for this include all units available for the selection of PV. This will set the units for the flow rate or process temperature.

3.2.13 Range values

Field Comm.	1, 3, 8

Range Values enables you to maximize resolution of analog output. The meter is most accurate when operated within the expected flow ranges for your application. Setting the range to the limits of expected readings will maximize flowmeter performance.

The range of expected readings is defined by the Lower Range Value (LRV) and Upper Range Value (URV). Set the LRV and URV within the limits of flowmeter operation as defined by the line size and process material for your application. Values set outside that range will not be accepted.

Primary Variable Upper Range Value (PV URV)

Field Comm.	1, 3, 8, 1

This is the 20 mA set point for the meter.

Primary Variable Lower Range Value (PV LRV)

Field Comm.	1, 3, 8, 2

This is the 4 mA set point for the meter, and is typically set to 0 when the PV is a Flow Variable.

3.2.14 PV damping

Field Comm.	1, 3, 9

Damping changes the response time of the flowmeter to smooth variations in output readings caused by rapid changes in input. Damping is applied to the Analog Output, Primary Variable, Percent of Range, and Vortex Frequency. This will not affect the Pulse Output, Total, or other Digital Information.

The default damping value is 2.0 seconds. This can be reset to any value between 0.2 to 255 seconds when PV is a flow variable or 0.4 to 32 seconds when PV is Process Temperature. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics in your system.

Note
If the vortex shedding frequency is slower than the damping value selected, no damping is applied.

3.2.15 Auto adjust filter

Field Comm.	1,3, Scroll to Bottom

The Auto Adjust Filter is a function that can be used to optimize the range of the flowmeter based on the density of the fluid. The electronics uses process density to calculate the minimum measurable flow rate, while retaining at least a 4:1 signal to the trigger level ratio. This function will also reset all of the filters to optimize the flowmeter performance over the new range. If the configuration of the device has changed, this method should be executed to ensure the signal processing parameters are set to their optimum settings. For a stronger signal select a density value that is lower than the actual flowing density.

Figure 3-1. Field Communicator Menu Tree for the Rosemount 8600D

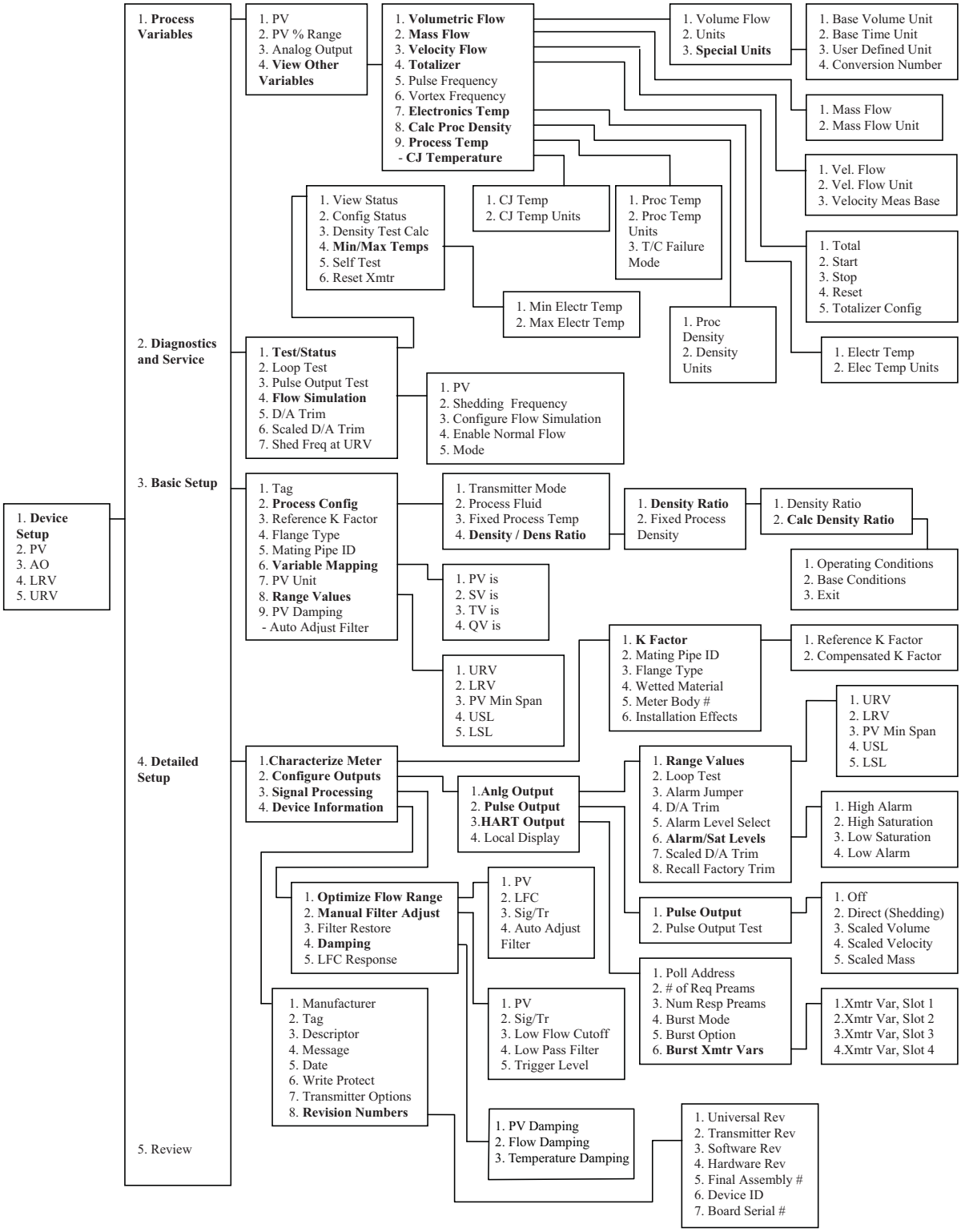


Table 3-2. Field Communicator Fast Key Sequences for the Rosemount 8600D

Function	Fast Keys
Alarm Jumper	1, 4, 2, 1, 3
Analog Output (Config)	1, 4, 2, 1
Analog Output (View)	1, 1, 3
Auto Adjust Filter	1, 4, 3, 1, 4
Base Time Unit	1, 1, 4, 1, 3, 2
Base Volume Unit	1, 1, 4, 1, 3, 1
Burst Mode	1, 4, 2, 3, 4
Burst Option	1, 4, 2, 3, 5
Burst Variable 1	1, 4, 2, 3, 6, 1
Burst Variable 2	1, 4, 2, 3, 6, 2
Burst Variable 3	1, 4, 2, 3, 6, 3
Burst Variable 4	1, 4, 2, 3, 6, 4
Burst Xmtr Variables	1, 4, 2, 3, 6
Conversion Number	1, 1, 4, 1, 3, 4
D/A Trim	1, 2, 5
Date	1, 4, 4, 5
Descriptor	1, 4, 4, 3
Density Ratio	1, 3, 2, 4, 1, 1
Device ID	1, 4, 4, 7, 6
Electronics Temp	1, 1, 4, 7, 1
Electronics Temp Units	1, 1, 4, 7, 2
Filter Restore	1, 4, 3, 3
Final Assembly Number	1, 4, 4, 7, 5
Fixed Process Density	1, 3, 2, 4, 2
Fixed Process Temperature	1, 3, 2, 3
Flange Type	1, 3, 4
Flow Simulation	1, 2, 4
Installation Effects	1, 4, 1, 6
K-Factor (reference)	1, 3, 3
Local Display	1, 4, 2, 4
Loop Test	1, 2, 2
Low Flow Cutoff	1, 4, 3, 2, 3
Low Pass Filter	1, 4, 3, 2, 4
LRV	1, 3, 8, 2
LSL	1, 3, 8, 5
Manufacturer	1, 4, 4, 1
Mass Flow	1, 1, 4, 2, 1
Mass Flow Units	1, 1, 4, 2, 2
Mating Pipe ID (Inside Diameter)	1, 3, 5
Message	1, 4, 4, 4
Meter Body Number	1, 4, 1, 5
Minimum Span	1, 3, 8, 3
Num Req Preams	1, 4, 2, 3, 2

Function	Fast Keys
Poll Address	1, 4, 2, 3, 1
Process Fluid Type	1, 3, 2, 2
Process Variables	1, 1
Pulse Output	1, 4, 2, 2, 1
Pulse Output Test	1, 4, 2, 2, 2
PV Damping	1, 3, 9
PV Mapping	1, 3, 6, 1
PV Percent Range	1, 1, 2
QV Mapping	1, 3, 6, 4
Range Values	1, 3, 8
Review	1, 5
Revision Numbers	1, 4, 4, 7
Scaled D/A Trim	1, 2, 6
Self Test	1, 2, 1, 5
Signal to Trigger Ratio	1, 4, 3, 2, 2
STD/Nor Flow Units	1, 1, 4, 1, 2
Special Units	1, 1, 4, 1, 3
Status	1, 2, 1, 1
SV Mapping	1, 3, 6, 2
Tag	1, 3, 1
Total	1, 1, 4, 4, 1
Totalizer Control	1, 1, 4, 4
Transmitter Mode	1, 3, 2, 1
TV Mapping	1, 3, 6, 3
Trigger Level	1, 4, 3, 2, 5
URV	1, 3, 8, 1
User Defined Units	1, 1, 4, 1, 3, 3
USL	1, 3, 8, 4
Shedding Frequency	1, 1, 4, 6
Variable Mapping	1, 3, 6
Velocity Flow	1, 1, 4, 3
Velocity Flow Base	1, 1, 4, 3, 3
Volumetric Flow	1, 1, 4, 1
Wetted Material	1, 4, 1, 4
Write Protect	1, 4, 4, 6

Section 4 Operation

Diagnostics/service . . . . . page 47
Advanced functionality . . . . . page 51
Detailed set-up . . . . . page 51

This section contains information for advanced configuration parameters and diagnostics.

The software configuration settings for the Rosemount 8600D can be accessed through a HART-based communicator or through a control system. The software functions for the Field Communicator are described in detail in this section of the manual. It provides an overview and summary of communicator functions. For more complete instructions, see the communicator manual.

Before operating the Rosemount 8600D in an actual installation, you should review all of the factory set configuration data to ensure that they reflect the current application.

4.1 Diagnostics/service

Field Comm.	1, 2

Use the following functions to verify that the flowmeter is functioning properly, or when you suspect component failure or a problem with loop performance, or when instructed to do so as part of a troubleshooting procedure. Initiate each test with the Field Communicator or other HART-based communications device.

4.1.1 Test/status

Field Comm.	1, 2, 1

Under Test/Status choose from View Status or Self Test.

View status

Field Comm.	1, 2, 1, 1

Allows you to view any error messages that may have occurred.

Configuration status

Field Comm.	1, 2, 1, 2

Configuration status allows you to check the validity of the transmitter configuration.

Density test calc

Field Comm.	1, 2, 1, 3

Allows for the test of the density calculation for saturated steam. The vortex meter will calculate the associated steam density at a user entered temperature value. Process Fluid must be set to Tcomp Sat Steam in order to run this test.

Min/Max electronics temperatures

Field Comm.	1, 2, 1, 4

Allows the user to view the minimum and maximum temperatures that the electronics have been exposed to.

Min electronics temp

Field Comm.	1, 2, 1, 4, 1

Displays the lowest temperature that the electronics have been exposed to.

Max electronics temp

Field Comm.	1, 2, 1, 4, 2

Displays the highest temperature that the electronics have been exposed to.

Self test

Field Comm.	1, 2, 1, 5

Although the Rosemount 8600D performs continuous self-diagnostics, you can initiate an immediate diagnostic to check for possible electronics failure.

Self Test checks proper communications with the transmitter and provides diagnostic capabilities for transmitter problems. Follow on-screen instructions if problems are detected, or check the appropriate appendix for error messages relating to your transmitter.

Reset transmitter

Field Comm.	1, 2, 1, 6

Restarts the transmitter - same as cycling power.

4.1.2 Loop test

Field Comm.	1, 2, 2

Loop Test verifies the output of the flowmeter, the integrity of the loop, and the operation of any recorders or similar devices. Conduct the loop test after the flowmeter is installed in the field.

If the meter is located in a loop with a control system, the loop will have to be set to manual control before the loop test is performed.

Loop Test allows the device to be set to any output between the Low Alarm and High Alarm.

4.1.3 Pulse output test

Field Comm.	1, 2, 3

Pulse Output Test is a fixed frequency mode test that checks the integrity of the pulse loop. It tests that all connections are good and that the pulse output is running on the loop.

4.1.4 Flow simulation

Field Comm.	1, 2, 4

Flow Simulation enables you to check the electronics functionality. This can be verified with either the Flow Simulation Internal or Flow Simulation External method. PV must be Volume Flow, Velocity Flow, or Mass Flow before Flow Simulation can be used.

PV

Field Comm.	1, 2, 4, 1

Shows the flow value in current engineering units for the flow simulation.

Shedding frequency

Field Comm.	1, 2, 4, 2

Shows the shedding frequency for the flow simulation.

Configure flow simulation

Field Comm.	1, 2, 4, 3

Allows you to configure your flow simulation (internal or external).

Simulate flow internal

Field Comm.	1, 2, 4, 3, 1

When licensed, the simulate flow internal function will automatically electronically disconnect the sensor and enable you to configure the internal flow simulation (fixed or varying).

Fixed flow

Field Comm.	1, 2, 4, 3, 1, 1

The fixed flow simulation signal can be entered in either a percent of range or flow rate in current engineering units. This simulation locks the Vortex in to the specific flow rate entered.

Varying flow

Field Comm.	1, 2, 4, 3, 1, 2

The minimum and maximum flowrate can be entered in either percent of range or as a flow rate in current engineering units. The ramp time can be entered in seconds from a minimum of 0.6 seconds to a maximum of 34951 seconds. This simulation causes the Vortex meter to continuously ramp from the minimum entered rate to the maximum entered rate and back over the ramp time.

Simulate flow external

Field Comm.	1, 2, 4, 3, 2

Simulate flow external allows you to disconnect the sensor electronically so an external frequency source can be used to test and verify the electronics.

Enable normal flow

Field Comm.	1, 2, 4, 4

Enable normal flow allows you to exit the flow simulation mode (internal or external) and return to normal operation mode. Enabled Normal Flow must be activated after any simulation is run. Failure to enable normal flow will leave the Vortex in simulation mode.

Mode

Field Comm.	1, 2, 4, 5

Mode allows you to view which flow simulation mode you are in:

- Internal (flow simulation – internal)
- Snsr Offln (flow simulation – external)
- Norm Flow (normal flow operation)

4.1.5 D/A trim

Field Comm.	1, 2, 5

D/A Trim (Digital-to-Analog Trim) enables you to check and trim the analog output in a single function. If the analog output is trimmed, it will be scaled proportionally through the range of the output.

To trim the digital-to-analog output, initiate the D/A Trim function and connect an ammeter to the loop to measure the actual analog output of the meter. Follow the on-screen functions to complete the task.

4.1.6 Scaled D/A trim

Field Comm.	1, 2, 6

Scaled D/A Trim enables you to calibrate the flowmeter analog output using a different scale than the standard 4-20 mA output scale. Non-scaled D/A Trimming (described above), is typically performed using an ammeter where calibration values are entered in units of milliamperes. Both non-scaled D/A trimming and scaled D/A trimming allow you to trim the 4-20mA output to approximately ±5% of the nominal 4mA end point and ±3% of the nominal 20mA end point. Scaled D/A Trimming allows you to trim the flowmeter using a scale that may be more convenient based upon your method of measurement.

For example, it may be more convenient for you to make current measurements by direct voltage readings across the loop resistor. If your loop resistor is 500 Ohms, and you want to calibrate the meter using voltage measurements made across this resistor, you could rescale (select CHANGE on the 375) your trim points from 4-20 mA to 4-20 mA x 500 ohm or 2-10 Vdc.

Once your scaled trim points have been entered as 2 and 10, you can now calibrate your flowmeter by entering voltage measurements directly from the voltmeter.

4.1.7 Shed freq at URV

Field Comm.	1, 2, 7

Shed Freq at URV function gives the shedding frequency corresponding to your URV (URV = Upper Range Value). If the PV is Process Temperature, the Shedding Frequency at URV represents the shedding frequency of the Volumetric Flow URV. This can be set by assigning Volumetric Flow to PV and setting range values.

4.2 Advanced functionality

The Rosemount 8600D enables you to configure the flowmeter for a wider range of applications and special situations. These functions are grouped as follows under Detailed Set-Up:

4.3 Detailed set-up

Field Comm.	1, 4

- Characterize Meter
- Configure Outputs
- Signal Processing
- Device Information

4.3.1 Characterize meter

Field Comm.	1, 4, 1

The Meter Body variables provide configuration data that are unique to your Rosemount 8600D. The settings of these variables can affect the compensated K-factor on which the primary variable is based. This data is provided during factory configuration and should not be changed unless the physical make-up of your Rosemount 8600D is changed.

K-factor

Field Comm.	1, 4, 1, 1

The Field Communicator provides information on Reference and Compensated K-factor values.

The *Reference K-factor* is factory set according to the actual K-factor for your application. It should only be changed if you replace parts of the flowmeter. Contact your Rosemount representative for details.

The *Compensated K-factor* is based on the reference K-factor as compensated for the given process temperature, wetted materials, body number, and pipe ID. Compensated K-factor is an informational variable that is calculated by the electronics of your flowmeter.

Mating pipe I.D.

Field Comm.	1, 4, 1, 2

The inside diameter of the pipe adjacent to the flow meter can cause entrance effects that may alter flowmeter readings. The exact inside diameter of the pipe must be specified to correct for these effects. Enter the appropriate value for this variable.

Mating Pipe ID values for schedule 10, 40, 80, and 160 piping are given in Table 3-1 on page 41. If the piping in your application is not one of these, you may need to contact the manufacturer for exact Pipe ID.

Flange type

Field Comm.	1, 4, 1, 3

Flange Type enables you to specify the type of flange on the flowmeter for later reference. This variable is preset at the factory but can be changed if necessary.

- ANSI 150
- ANSI 300
- PN16
- PN40
- Spcl

Wetted material

Field Comm.	1, 4, 1, 4

Wetted Material is a factory set configuration variable that reflects the construction of your flowmeter.

- 316 SST
- Spcl

Meter body number

Field Comm.	1, 4, 1, 5

Meter Body Number is a factory set configuration variable that stores the body number of your particular flowmeter and the type of construction. The meter body number is found to the right of the body number on the meter body tag, which is attached to the bracket of the meter body.

The format of this variable is a number followed by an alpha character. The number designates the body number.

Installation effect

Field Comm.	1, 4, 1, 6

Installation Effect enables you to compensate the flowmeter for installation effects caused by less than ideal straight run piping. See reference graphs located in Technical Data Sheet 00816-0100-3250 for the percent of K-factor shift based on entrance effects of upstream disturbances. This value is entered as a percentage of the range of -1.5% to +1.5%.

4.3.2 Configure outputs

Field Comm.	1, 4, 2

The Rosemount 8600D is digitally adjusted at the factory using precision equipment to ensure accuracy. You should be able to install and operate the flowmeter without a D/A Trim.

Analog output

Field Comm.	1, 4, 2, 1

For maximum accuracy, calibrate the analog output and, if necessary, trim for your system loop. The D/A Trim procedure alters the conversion of the digital signal into an analog 4–20 mA output.

Range values

Field Comm.	1, 4, 2, 1, 1

Range Values enables you to maximize resolution of analog output. The meter is most accurate when operated within the expected flow ranges for your application. Setting the range to the limits of expected readings will maximize flowmeter performance.

The range of expected readings is defined by the Lower Range Value (LRV) and Upper Range Value (URV). Set the LRV and URV within the limits of flowmeter operation as defined by the line size and process material for your application. Values set outside that range will not be accepted.

Loop test

Field Comm.	1, 4, 2, 1, 2

Loop Test verifies the output of the flowmeter, the integrity of the loop, and the operation of any recorders or similar devices. Conduct the loop test after the flowmeter is installed in the field. If the meter is located in a loop with a control system, the loop will have to be set to manual control before the loop test is performed.

Loop Test allows the device to be set to any output between the Low Alarm and High Alarm.

Alarm jumper

Field Comm.	1, 4, 2, 1, 3

Alarm Jumper lets you verify the alarm jumper setting.

D/A trim (Digital-to-Analog trim)

Field Comm.	1, 4, 2, 1, 4

Digital-to-Analog Trim enables you to check and trim the analog output in a single function. If the analog output is trimmed, it will be scaled proportionally through the range of the output. To trim the digital-to-analog output, initiate the D/A Trim function and connect an ammeter to the loop to measure the actual analog output of the meter. Follow the on-screen functions to complete the task.

Alarm level select

Field Comm.	1, 4, 2, 1, 5

Select the Alarm level of the transmitter. Either Rosemount standard or NAMUR compliant.

Alarm / sat levels

Field Comm.	1, 4, 2, 1, 6

Displays Alarm and Saturation mA output levels.

Note
Alarm and Saturation levels can be found in the specifications section.

Scaled D/A trim

Field Comm.	1, 4, 2, 1, 7

Scaled D/A Trim enables you to calibrate the flowmeter analog output using a different scale than the standard 4-20 mA output scale. Non-scaled D/A Trimming (described above), is typically performed using an ammeter where calibration values are entered in units of milliamperes. Both non-scaled D/A trimming and scaled D/A trimming allow you to trim the 4-20mA output to approximately ±5% of the nominal 4mA end point and ±3% of the nominal 20mA end point. Scaled D/A Trimming allows you to trim the flowmeter using a scale that may be more convenient based upon your method of measurement.

For example, it may be more convenient for you to make current measurements by direct voltage readings across the loop resistor. If your loop resistor is 500 Ohms, and you want to calibrate the meter using voltage measurements made across this resistor, you could rescale your trim points from 4-20mA to 4-20mA x 500 ohm or 2-10 Vdc. Once your scaled trim points have been entered as 2 and 10, you can now calibrate your flowmeter by entering voltage measurements directly from the voltmeter.

Recall factory Trim

Field Comm.	1, 4, 2, 1, 8

Recall Factory Trim enables you to return to the original factory trim values.

Pulse output

Field Comm.	1, 4, 2, 2

Pulse Output enables you to configure the Pulse Output.

Note
The Field Communicator will allow configuration of the pulse features even if the pulse option (Option P) was not ordered.

Pulse output

Field Comm.	1, 4, 2, 2, 1

The Rosemount 8600D comes with an optional pulse output option (P). This enables the flowmeter to output the pulse rate to an external control system, totalizer, or other device. If the flowmeter was ordered with the pulse mode option, it may be configured for either pulse scaling (based on rate or unit) or shedding frequency output. There are four methods for configuring the pulse output:

- Off
- Direct (Shedding Frequency)
- Scaled Volume
- Scaled Velocity
- Scaled Mass

Direct (shedding frequency)

Field Comm.	1, 4, 2, 2, 1, 2

This mode provides the vortex shedding frequency as output. In this mode, the software does not compensate the K-factor for effects such as thermal expansion or differing mating pipe inside diameters. Scaled pulse mode must be used to compensate the K-factor for thermal expansion and mating pipe effects.

Scaled volume

Field Comm.	1, 4, 2, 2, 1, 3

This mode allows you to configure the pulse output based on a volumetric flow rate. For example, set 100 gallons per minute = 10,000 Hz. (The user enterable parameters are flow rate and frequency.)

Pulse scaling rate

Field Comm.	1, 4, 2, 2, 1, 3, 1

Pulse scaling rate allows the user to set a certain volume flow rate to a desired Frequency.

For example:

1. Enter a flow rate of 100 gallons per minute.
2. Enter a frequency of 10,000 Hz.

Pulse scaling unit

Field Comm.	1, 4, 2, 2, 1, 3, 2

Pulse scaling unit allows the user to set one pulse equal to a desired volume.

For example:

1 pulse = 100 gal. Enter 100 for the Flow Rate.

Scaled velocity

Field Comm.	1, 4, 2, 2, 1, 4

This mode allows you to configure the pulse output based on a velocity Flow Rate.

Pulse scaling rate

Field Comm.	1, 4, 2, 2, 1, 4, 1

Allows the user to set a certain velocity flow rate to a desired frequency.

For example:

10 ft/sec = 10,000HZ

1. Enter a Flow rate of 10 ft/sec.
2. Enter a Frequency of 10,000HZ.

Pulse scaling unit

Field Comm.	1, 4, 2, 2, 1, 4, 2

Allows the user to set one pulse equal to a desired distance.

For example:

1 pulse = 10 ft. Enter 10 for the distance.

Scaled mass

Field Comm.	1, 4, 2, 2, 1, 5

This mode allows you to configure the pulse output based on a mass Flow Rate. If Process Fluid = Tcomp Sat Steam, this is a temperature compensated mass flow.

Pulse scaling rate

Field Comm.	1, 4, 2, 2, 1, 5, 1

Allows the user to set a certain mass Flow Rate to a desired Frequency.

For example:

1000 lbs/hr = 1000HZ

1. Enter a Flow rate of 1000 lbs/hr.
2. Enter a Frequency of 1000HZ.

Pulse scaling unit

Field Comm.	1, 4, 2, 2, 1, 5, 2

Allows the user to set one pulse equal to a desired mass.

For example:
1 pulse = 1000lbs.
Enter 1000 for the mass.

Pulse output test

Field Comm.	1, 4, 2, 2, 2

Pulse Output Test is a fixed frequency mode test that checks the integrity of the pulse loop. It tests that all connections are good and that pulse output is running on the loop.

HART output

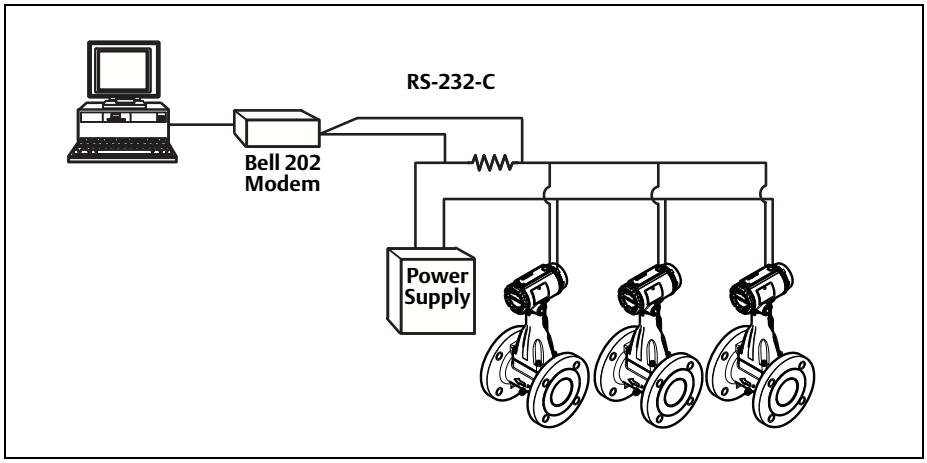
Field Comm.	1, 4, 2, 3

Multidrop configuration refers to the connection of several flowmeters to a single communications transmission line. Communication occurs digitally between a HART-based communicator or control system and the flowmeters. Multidrop mode automatically deactivates the analog output of the flowmeters. Using the HART communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines.

The use of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Multidrop installations are not recommended where intrinsic safety is a requirement. Communication with the transmitters can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each transmitter is identified by a unique address (1-15) and responds to the commands defined in the HART protocol.

Figure 4-1 shows a typical multidrop network. This figure is not intended as an installation diagram. Contact Rosemount product support with specific requirements for multidrop applications.

Figure 4-1. Typical Multidrop Network



Note
The Rosemount 8600D is set to poll address zero at the factory, allowing it to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter poll address must be changed to a number between 1 and 15. This change deactivates the 4–20 mA analog output, setting it to 4 mA, and disables the failure mode alarm signal.

Poll address

Field Comm.	1, 4, 2, 3, 1

Poll Address enables you to set the poll address for a multi-dropped meter. The poll address is used to identify each meter on the multi-drop line. Follow the on-screen instructions to set the address at a number from 1 to 15. To set or change the flowmeter address, establish communication with the selected Rosemount 8600D in the loop.

Auto poll

Field Comm.	OFF LINE FCN

When a HART-based communicator is powered up and auto polling is on, the communicator automatically polls the flowmeter addresses to which it is connected. If the address is 0, the HART-based communicator enters its normal online mode. If it detects an address other than 0, the communicator finds each device in the loop and lists them by poll address and tag. Scroll through the list and select the meter with which you need to communicate.

If Auto Poll is off, the flowmeter must have the poll address set to 0 or the flowmeter will not be found. If a single connected device has an address other than zero and auto polling is off, the device will not be found either.

Number of required preams

Field Comm.	1, 4, 2, 3, 2

This is the number of preambles required by the 8600D for HART communications.

Number of response preams

Field Comm.	1, 4, 2, 3, 3

This is the number of preambles sent by the transmitter in response to any host request.

Burst mode

Field Comm.	1, 4, 2, 3, 4

Burst mode configuration

The Rosemount 8600D includes a burst mode function that broadcasts the primary variable or all dynamic variables approximately three to four times a second. The burst mode is a specialized function used in very specific applications. The burst mode function enables you to select the variables to broadcast while in the burst mode and to select the burst mode option.

The Burst Mode variable enables you to set the Burst Mode to the needs of your application. Options for the Burst Mode setting include:

Off–Turns off the Burst Mode so that no data are broadcast on the loop.

On–Turns Burst Mode on so that the data selected under Burst Option are broadcast over the loop.

Additional command options may appear that are reserved and do not apply to the Rosemount 8600D.

Burst option

Field Comm.	1, 4, 2, 3, 5

Burst Option enables you to select the variables to broadcast over the burst transmitter. Choose one of the following options:

PV–Selects the process variable for broadcast over the burst transmitter.

Percent Range/Current–Selects the process variable as percent of range and analog output variables for broadcast over the burst transmitter.

Process vars/crnt–Selects the process variables and analog output variables for broadcast over the burst transmitter.

Dynamic Vars–Burst all dynamic variables in the transmitter.

Xmtr Vars–Allows the user to define custom burst variables. Select variables from the list below:

Volume Flow
Velocity Flow
Mass Flow
Vortex Frequency
Pulse Output Frequency
Totalizer Value
Process Temperature (MTA Option Only)
Calculated Process Density (MTA Option Only)
Cold Junction Temperature (MTA Option Only)
Electronics Temperature

Burst XMTR vars

Field Comm.	1, 4, 2, 3, 6

Allows users to select and define Burst Variables.

XMTR variable slot 1

Field Comm.	1, 4, 2, 3, 6, 1

User selected Burst Variable 1.

XMTR variable slot 2

Field Comm.	1, 4, 2, 3, 6, 2

User selected Burst Variable 2.

XMTR variable slot 3

Field Comm.	1, 4, 2, 3, 6, 3

User selected Burst Variable 3.

XMTR variable slot 4

Field Comm.	1, 4, 2, 3, 6, 4

User selected Burst Variable 4.

Local display

Field Comm.	1, 4, 2, 4

The Local Display function on the Rosemount 8600D allows you to select which variables are shown on the optional (M5) local display. Choose from the following variables:

- Primary Variable
- Loop Current
- Percent of Range
- Totalizer
- Shedding Frequency
- Mass Flow
- Velocity Flow
- Volumetric Flow
- Pulse Output Frequency
- Electronics Temperature
- Process Temperature (MTA Option Only)
- Calculated Process Density (MTA Option Only)

4.3.3 Signal processing

Field Comm.	1, 4, 3

The Rosemount 8600D and its HART-based communications feature enable you to filter out noise and other frequencies from the transmitter signal. The four user-alterable parameters associated with the digital signal processing on the Rosemount 8600D include low-pass filter corner frequency, low-flow cutoff, trigger level, and damping. These four signal conditioning functions are configured at the factory for optimum filtering over the range of flow for a given line size and service type (liquid or gas). For most applications, leave these parameters at the factory settings. Some applications may require adjustment of the signal processing parameters.

Use signal processing only when recommended in the Troubleshooting section of this manual. Some of the problems that may require signal processing include:

- High output (output saturation)
- Erratic output with or without flow present
- Incorrect output (with known flow rate)
- No output or low output with flow present
- Low total (missing pulses)
- High total (extra pulses)

If one or more of these conditions exist, and you have checked other potential sources (K-factor, service type, lower and upper range values, 4–20mA trim, pulse scaling factor, process temperature, pipe ID), refer to Section 5: Troubleshooting. Remember that the factory default settings can be re-established at any time with Filter Restore. If problems persist after signal processing adjustments, consult the factory.

Optimize flow range

Field Comm.	1, 4, 3, 1

The Optimize Flow Range function will automatically set the 8600D filter levels, Low Flow Cutoff (LFC), Trigger Level, and Low Pass Corner Frequency, to optimum settings based on the process density and process fluid type.

Primary Variable (PV)

Field Comm.	1, 4, 3, 1, 1

PV is the actual measured variable rate in the line. On the bench, the PV value should be zero. Check the units on the PV to make sure they are configured correctly. See PV Units if the units format is not correct. Use the Process Variable Units function to select the units for your application.

Low flow cutoff

Field Comm.	1, 4, 3, 1, 2

Low Flow Cutoff is shown in engineering units.

Signal/trigger level ratio (Sig/Tr)

Field Comm.	1, 4, 3, 1, 3

The Signal to Trigger Level Ratio is a variable that indicates the flow signal strength to trigger level ratio. This ratio indicates if there is enough flow signal strength for the meter to work properly. For accurate flow measurement, the ratio should be greater than 4:1. Values greater than 4:1 will allow increased filtering for noisy applications. For ratios greater than 4:1, with sufficient density, the Auto Adjust Filter function can be utilized to optimize the measurable range of the flowmeter.

Ratios less than 4:1 may indicate applications with very low densities and/or applications with excessive filtering.

Auto adjust filter

Field Comm.	1, 4, 3, 1, 4

The Auto Adjust Filter is a function that can be used to optimize the range of the flowmeter based on the density of the fluid. The electronics uses process density to calculate the minimum measurable flow rate, while retaining at least a 4:1 signal to the trigger level ratio. This function will also reset all of the filters to optimize the flowmeter performance over the new range. For a stronger signal select a density value that is lower than the actual flowing density.

Manual filter adjust

Field Comm.	1, 4, 3, 2

Manual Filter Adjust allows you to manually adjust the following settings: Low Flow Cutoff, Low Pass Filter, and Trigger Level, while monitoring flow and or sig/tr.

Primary Variable (PV)

Field Comm.	1, 4, 3, 2, 1

PV is the actual measured variable. Check the units on the PV to make sure they are configured correctly. See PV Units if the units format is not correct. Use the Process Variable Units function to select the units for your application.

Signal/trigger level ratio (Sig/Tr)

Field Comm.	1, 4, 3, 2, 2

The Signal to Trigger Level Ratio is a variable that indicates the flow signal strength to trigger level ratio. This ratio indicates if there is enough flow signal strength for the meter to work properly. For accurate flow measurement, the ratio should be greater than 4:1. Values greater that 4:1 will allow increased filtering for noisy applications. For ratios greater than 4:1, with sufficient density, the Optimize Flow Range function can be utilized to optimize the measurable range of the flowmeter.

Ratios less than 4:1 may indicate applications with very low densities and/or applications with excessive filtering.

Low flow cutoff

Field Comm.	1, 4, 3, 2, 3

Low Flow Cutoff enables you to adjust the filter for noise at no flow. It is set at the factory to handle most applications, but certain applications may require adjustment either to expand measurability or to reduce noise.

The Low Flow Cutoff offers two modes for adjustment:

- Increase Range
- Decrease No Flow Noise

It also includes a dead band such that once flow goes below the cutoff value, output does not return to the normal flow range until flow goes above the dead band. The dead band extends to approximately 20 percent above the low flow cutoff value. The dead band prevents the output from bouncing between 4mA and normal flow range if the flow rate is near the low flow cutoff value.

Low pass filter

Field Comm.	1, 4, 3, 2, 4

The Low Pass Filter sets the low-pass filter corner frequency to minimize the effects of high frequency noise. It is factory set based
on line size and service type. Adjustments may be required only if
you are experiencing problems. See Section 5: Troubleshooting.

The Low Pass Filter corner frequency variable offers two modes for adjustment:

- Increase filtering
- Increase sensitivity

Trigger level

Field Comm.	1, 4, 3, 2, 5

Trigger Level is configured to reject noise within the flow range while allowing normal amplitude variation of the vortex signal. Signals of amplitude lower than the Trigger Level setting are filtered out. The factory setting optimizes noise rejection in most applications. Trigger Level offers two modes for adjustment:

- Increase filtering
- Increase sensitivity

Note
Do not adjust this parameter unless directed to do so by a Rosemount Technical Support Representative.

Filter restore

Field Comm.	1, 4, 3, 3

Filter Restore enables you to return all of the signal conditioning variables to their default values. Should the filter settings get confused, select Filter Restore to restore the default settings and provide a new starting point.

Damping

Field Comm.	1, 4, 3, 4

Damping function changes the response time of the flowmeter to smooth variations in output readings caused by rapid changes in input.

The appropriate damping setting can be determined based on the necessary response time, signal stability, and other requirements of the loop dynamics in your system.

PV damping

Field Comm.	1, 4, 3, 4, 1

The default damping value is 2.0 seconds. Damping can be reset to any value between 0.2 and 255 seconds when PV is a flow variable or 0.4 to 32 seconds when PV is Process Temperature.

Flow damping

Field Comm.	1, 4, 3, 4, 2

The default damping value is 2.0 seconds. Flow Damping can be reset to any value between 0.2 and 255 seconds.

Temperature damping

Field Comm.	1, 4, 3, 4, 3

The default damping value is 2.0 seconds. Temperature Damping can be reset to any value between 0.4 and 32 seconds.

LFC response

Field Comm.	1, 4, 3, 5

Defines how the output of the Vortex meter will behave entering into and coming out of the Low Flow Cutoff. Options are stepped or damped. (See Technical Note 00840-0200-4004 for more information regarding Low Flow Measurement).

4.3.4 Device information

Field Comm.	1, 4, 4

Information variables are used for identification of flowmeters in the field and to store information that may be useful in service situations. Information variables have no effect on flowmeter output or process variables.

Manufacturer

Field Comm.	1, 4, 4, 1

Manufacturer is an informational variable provided by the factory. For the Rosemount 8600D, the Manufacturer is Rosemount.

Tag

Field Comm.	1, 4, 4, 2

Tag is the quickest variable to identify and distinguish between flowmeters. Flowmeters can be tagged according to the requirements of your application. The tag may be up to eight characters long.

Descriptor

Field Comm.	1, 4, 4, 3

Descriptor is a longer user-defined variable to assist with more specific identification of the particular flowmeter. It is usually used in multi-flowmeter environments and provides 16 characters.

Message

Field Comm.	1, 4, 4, 4

The Message variable provides an even longer user-defined variable for identification and other purposes. It provides 32 characters of information and is stored with the other configuration data.

Date

Field Comm.	1, 4, 4, 5

Date is a user-defined variable that provides a place to save a date, typically used to store the last date that the transmitter configuration was changed.

Write protect

Field Comm.	1, 4, 4, 6

Write Protect is a read-only informational variable that reflects the setting of the hardware security switch. If Write Protect is ON, configuration data are protected and cannot be changed from a HART-based communicator or control system. If Write Protect is OFF, configuration data may be changed using the communicator or control system.

Transmitter options

Field Comm.	1, 4, 4, 7

Transmitter Options indicates if Internal Flow Simulation option is enabled.

Revision numbers

Field Comm.	1, 4, 4, 8

Revisions Numbers are fixed informational variables that provide the revision number for different elements of your Field Communicator and Rosemount 8600D. These revision numbers may be required when calling the factory for support. Revision numbers can only be changed at the factory and are provided for the following elements:

Universal rev

Field Comm.	1, 4, 4, 8, 1

Universal Rev – Designates the HART Universal Command specification to which the transmitter is designed to conform.

Transmitter rev

Field Comm.	1, 4, 4, 8, 2

Transmitter Rev – Designates the revision for Rosemount 8600D specific command identification for HART compatibility.

Software rev

Field Comm.	1, 4, 4, 8, 3

Software Rev – Designates the internal software revision level for the Rosemount 8600D.

Hardware rev

Field Comm.	1, 4, 4, 8, 4

Hardware Rev – Designates the revision level for the Rosemount 8600D hardware.

Final assembly number

Field Comm.	1, 4, 4, 8, 5

Final Assembly Number – Factory set number that refers to the electronics of your flowmeter. The number is configured into the flowmeter for later reference.

Device ID

Field Comm.	1, 4, 4, 8, 6

Device ID – Factory-defined unique identifier for transmitter identification in the software. Device ID is not user changeable.

Section 5 Troubleshooting

Safety messages . . . . . page 67
Troubleshooting tables . . . . . page 68
Advanced troubleshooting . . . . . page 69
Diagnostic messages on LCD . . . . . page 73
Testing procedures . . . . . page 75
Hardware replacement . . . . . page 75
Return of material . . . . . page 89

"Troubleshooting tables" on page 68 provides summarized troubleshooting suggestions for the most common problems that occur during operation. The symptoms of metering problems include:

- Communications problems with a HART-based communicator.
- Incorrect 4–20 mA output.
- Incorrect pulse output.
- Error messages on HART-based communicator.
- Flow in pipe but no transmitter output.
- Flow in pipe with incorrect transmitter output.
- Output with no actual flow.

Note
The Rosemount 8600D sensor is extremely reliable and should not have to be replaced. Please consult the factory before removing the sensor.

5.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any in this section.

⚠ WARNING

Explosions could result in death or serious injury:

- Do not remove the transmitter cover or thermocouple (MTA option only) from the electronics housing in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

Removing sensor WILL open process to atmosphere. Meter must be depressurized before removing sensor.

5.2 Troubleshooting tables

The most common problems experienced by users of the Rosemount 8600D are listed in "Troubleshooting tables" on page 68 along with potential causes of the problem and suggested corrective actions. See the Advanced Troubleshooting section if the problem you are experiencing is not listed here.

Symptom	Corrective Action	
Communication problems with HART-based Communicator	• Check for a minimum of 10.8 Vdc at transmitter terminals • Check communications loop with HART-based communicator. • Check for loop resistor (250 to 1000 ohms). • Measure loop resistor value (R_{loop}) and source power supply voltage (V_{ps}). Check that [V_{ps} - (R_{loop} x 0.024)] > 10.8 Vdc.	• Check for transmitter in multidrop mode. • Check for transmitter in burst mode. • Remove pulse connection if you have a three wire pulse installation. • Replace electronics.
Incorrect 4–20 mA Output	• Check for minimum 10.8 Vdc at transmitter terminals. • Check URV, LRV, Density, Special Units, LFC– compare these inputs with the sizing program results. Correct configuration. • Perform 4–20 mA loop test.	• Check for corrosion on terminal block. • Replace electronics if necessary. • Refer to "Advanced troubleshooting" on page 69. • See Appendix Appendix C Electronics verification for electronics verification procedure.
Incorrect Pulse Output	• Check that 4–20 mA output is correct. • Check pulse counter specifications. • Check pulse mode and scaling factor. (Make sure scaling factor is not inverted).	• Perform pulse test. • Select pulse scaling so that pulse output is less than 10,000Hz at URV.
Error Messages on HART-based Communicator	• See alphabetical listing in Table 5-1 on page 5-70."Diagnostic messages" on page 69	

Symptom	Corrective Action	
Flow in Pipe, No Output	Basics • Check to make the sure that the meter is installed with the arrow in the direction of process flow. • Perform basic checks for Incorrect 4–20 mA Output Problem (see Incorrect 4–20 mA Output). • Check and correct configuration parameters in this order: • Process Config - transmitter mode, process fluid, fixed process temperature, density/density ratio (if required), reference K-factor, flange type, mating pipe ID, variable mapping, PV unit, range values - (URV, LRV), PV damping, auto filter adjust, pulse mode and scaling (if used). • Check sizing. Make sure flow is within measurable flow limits. Use Instrument Toolkit for best sizing results. • Refer to "Advanced troubleshooting" on page 69. • See Appendix Appendix C Electronics verification for electronics verification procedure. Electronics • Run a self test with a HART-based interface tool. • Using sensor simulator, apply test signal. • Check configuration, LFC, trigger level, STD vs. actual flow units. • Replace electronics.	Application Problems • Calculate expected frequency (see Appendix Appendix C Electronics verification). If actual frequency is the same, check configuration. • Check that application meets viscosity and specific gravity requirements for the line size. • Recalculate back pressure requirement. If necessary and possible, increase back pressure, flow rate, or operating pressure. Sensor • Inspect coaxial sensor cable for cracks. Replace if necessary. • Check that sensor impedance at process temperature is > 1 Mega-Ohm (will function down to 0.5 Mega-Ohms). Replace sensor if necessary ("Replacing the sensor" on page 80). • Measure sensor capacitance at SMA connector (115-700pF).

5.3 Advanced troubleshooting

The Rosemount 8600D electronics provides several advanced troubleshooting features. These features enhance your ability to look inside the electronics and can be helpful for troubleshooting inaccurate readings. As shown in Figure 5-1, there are several test points located on the electronics.

5.3.1 Diagnostic messages

The following is a list of messages used by the Field Communicator and their corresponding descriptions.

Table 5-1. Diagnostic Messages

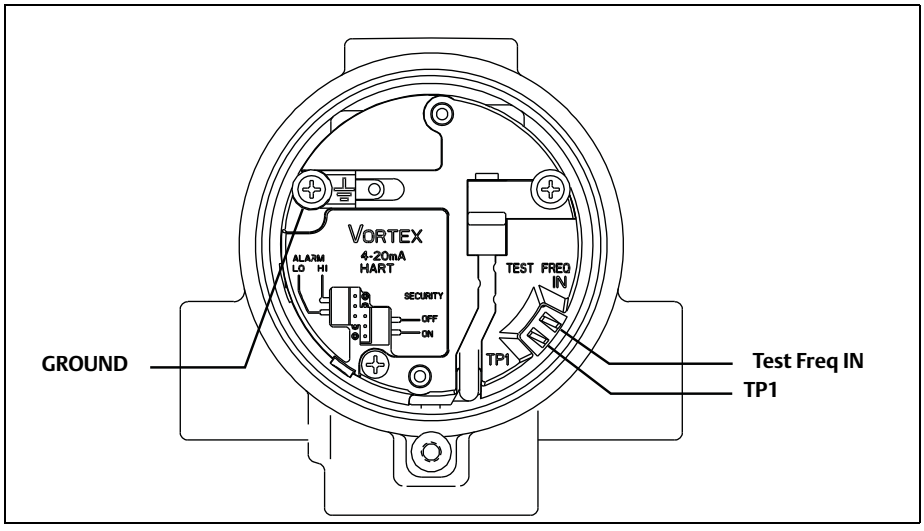
Message	Description
ROM CHECKSUM ERROR	The EPROM memory checksum test has failed. The transmitter will remain in ALARM until the ROM checksum test passes.
NV MEM CHECKSUM ERROR	The User Configuration area in Nonvolatile EEPROM memory has failed the checksum test. It is possible to repair this checksum by verifying and reconfiguring ALL transmitter parameters. The transmitter will remain in ALARM until the EEPROM checksum test passes.
RAM TEST ERROR	Transmitter RAM memory test has detected a failed RAM location. The transmitter will remain in ALARM until the RAM test passes.
DIGITAL FILTER ERROR	The digital filter in the transmitter electronics is not reporting. The transmitter will remain in ALARM until the digital signal processor resumes reporting flow data.
COPROCESSOR ERROR	If this occurs at power-up, the RAM/ROM test in the coprocessor has failed. If this occurs during normal operations, the coprocessor has reported either a math error or a negative flow. This is a FATAL error and the transmitter will remain in ALARM until reset.
SOFTWARE DETECTED ERROR	The software has detected corrupted memory. One or more of the software tasks has corrupted memory. This is a FATAL error and the transmitter will remain in ALARM until reset.
ELECTRONICS FAILURE	This is a summary error indication. This error will be reported if any of the following error conditions are present: 1. ROM Checksum Error 2. NV Memory Checksum Error 3. RAM Test Error 4. ASIC Interrupt Error 5. Digital FIlter Error 6. Coprocessor Error 7. Software Detected Error
TRIGGER LEVEL OVERRANGE	The trigger level in the transmitter digital signal processing has been set beyond its limit. Use manual filter adjustment to “Increase Filtering” or “Increase Sensitivity” to bring the trigger level back within range.
LOW PASS FILT OVERRANGE	The low pass filter in the transmitter digital signal processing has been set beyond its limit. Use manual filter adjustment to “Increase Filtering” or “Increase Sensitivity” to bring the low pass filter adjustment back within range.
ELECTRONICS TEMP OUT OF LIMITS	The electronics temperature sensor within the transmitter is reporting a value out of range.
INVALID CONFIGURATION	Certain configuration parameters are out of range. Either they have not been properly configured, or they have been forced out of range as a result of a change to a related parameter. For example: When using mass flow units, changing the process density to a value too low could push the configured Upper Range Value beyond the sensor limit. In this case, the Upper Range Value would need to be reconfigured.
FACTORY EEPROM CONFIG ERROR	The factory configured values in non-volatile EEPROM memory have become corrupted. This is a FATAL error. The transmitter will remain in ALARM until reset.
LOW FLOW CUTOFF OVERRANGE	On start-up, the configured setting for the VDSP Low Flow Cutoff setting was found to be too high or too low. The increase range or decrease no flow noise command of the VDSP Low Flow Cutoff setting has not yet brought the setting into a valid range. Continue adjusting the Low Flow Cutoff to a valid value or use the Filter Restore Option.
T/C A/D ERROR	The ASIC responsible for the analog to digital conversion of the process temperature thermocouple and cold junction RTD has failed. If the problem persists, replace the transmitter electronics.
THERMOCOUPLE OPEN	The thermocouple that is used to measure the process temperature has failed. Check the connections to the transmitter electronics. If the problem persists, replace the thermocouple.
CJ RTD FAILURE	The RTD temperature sensing device for sensing the cold junction temperature has failed. If the problem persists, replace the transmitter electronics.
FLOW SIMULATION	The transmitter flow signal is being simulated by a signal generator internal to the transmitter. The actual flow through the meter body is NOT being measured.
SENSOR SIGNAL IGNORED	The transmitter flow signal is being simulated by a signal generator external to the transmitter. The actual flow through the meter body is NOT being measured.

LOW LOOP VOLTAGE	The voltage at the transmitter terminals has dropped to a level that is causing the internal voltage supplies to drop, reducing the capability of the transmitter to accurately measure a flow signal. Check the terminal voltage and either increase the power supply voltage or reduce loop resistance.
INTERNAL COMM FAULT	After several attempts, the microprocessor failed in communication with the Sigma-Delta ASIC. A power cycle may resolve the problem. Also, check the inter-board connector. If the problem persists, replace the transmitter electronics.
INTERNAL SIGNAL FAULT	The flow data encoded on a pulse signal from the Sigma-Delta ASIC to VDSP has been lost. A power cycle may resolve the problem. Also check the inter-board connector. If the problem persists, replace the transmitter electronics.
TEMPERATURE ELECTRONICS FAILURE	The electronics circuitry that supports the measurement of the Process Temperature has failed. The transmitter can still be used in a non-Process Temperature mode.
PROCESS TEMP OUT OF RANGE	The Process Temperature is beyond the defined sensor limits of -50 °C to 427 °C.
PROCESS TEMP ABOVE SAT STEAM LIMITS	The Process Temperature is above the high limit for Saturated Steam density calculations. This status only occurs when the Process Fluid is Temperature Compensated Saturated Steam. The density calculation will continue using a Process Temperature of 320 °C.
PROCESS TEMP BELOW SAT STEAM LIMITS	The Process Temperature is below the low limit for Saturated Steam density calculations. This status only occurs when the Process Fluid is Temperature Compensated Saturated Steam. The density calculation will continue using a Process Temperature of 80 °C.
FIXED PROCESS TEMPERATURE IS ACTIVE	Due to a problem detected with the thermocouple, a configured fixed Process Temperature is being substituted for the measured Process Temperature. This fixed Process Temperature is also being used in saturated steam density calculations.
INVALID MATH COEFF	The area of nonvolatile memory used to store the curve fit coefficients for the coprocessor calculations does not contain valid data. This data can only be loaded at the factory. Replace the transmitter electronics.
CJ TEMP ABOVE SENSOR LIMITS	The temperature reported from the Cold Junction temperature sensor is above CJ sensor limits.
CJ TEMP BELOW SENSOR LIMITS	The temperature reported from the Cold Junction temperature sensor is below CJ sensor limits.

5.3.2 Electronics test points

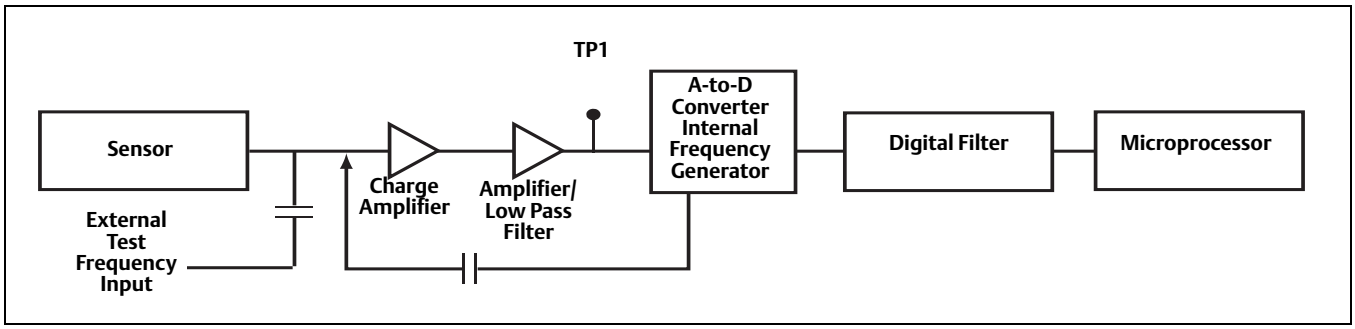
As shown in Figure 5-1, there are several test points located on the electronics.

Figure 5-1. Electronics Test Points



The electronics is capable of internally generating a flow signal that may be used to simulate a sensor signal to perform electronics verification with a Handheld Communicator or AMS interface. The simulated signal amplitude is based on the transmitter required minimum process density. The signal being simulated can be one of several profiles – a simulated signal of constant frequency or a simulated signal representative of a ramping flow rate. The electronics verification procedure is described in detail in Appendix C: Electronics verification. To verify the electronics, you can input a frequency on the "TEST FREQ IN" and "GROUND" pins to simulate flow via an external signal source such as a frequency generator. To analyze and/or troubleshoot the electronics, an oscilloscope (set for AC coupling) and a Handheld Communicator or AMS interface are required. Figure 5-2 is a block diagram of the signal as it flows from the sensor to the microprocessor in the electronics.

Figure 5-2. Signal Flow



5.3.3 TP1

TP1 is the vortex shedding signal after it has gone through the charge amplifier and low pass filter stages and into the input of the sigma delta A-to-D converter ASIC in the electronics. The signal strength at this point will be in the mV to Volt range.

TP1 is easily measured with standard equipment.

Figures 5-3, 5-4, and 5-5 show ideal (clean) waveforms and waveforms that may cause the output to be inaccurate. Please consult the factory if the waveform you detect is not similar in principle to these waveforms.

Figure 5-3. Clean Signals

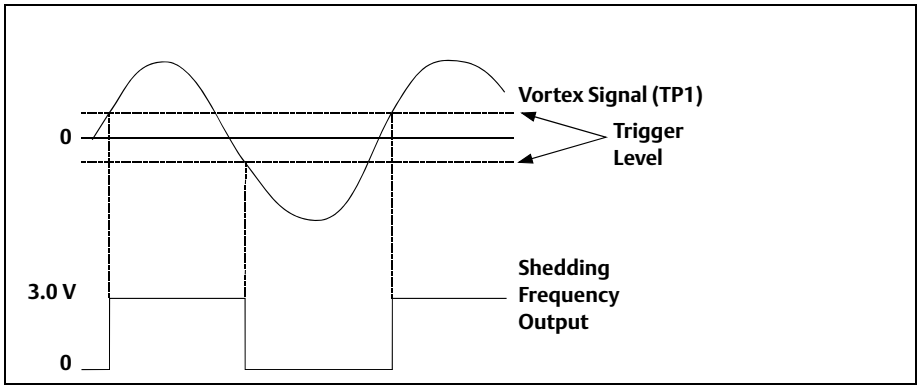


Figure 5-4. Noisy Signals

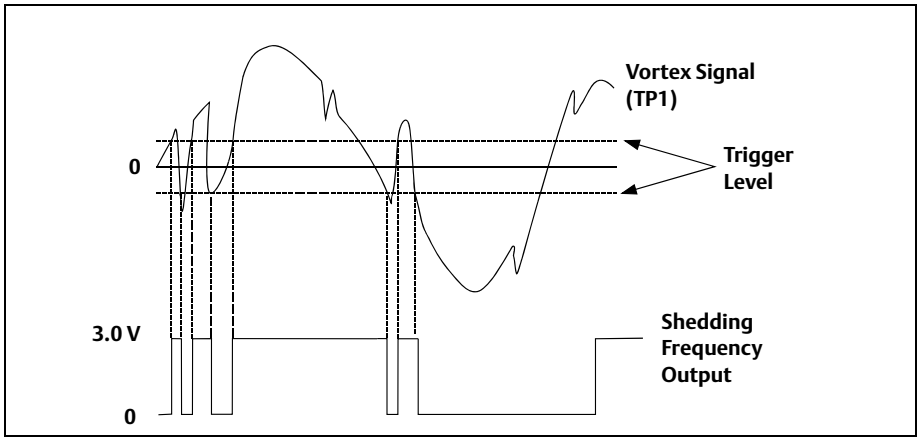
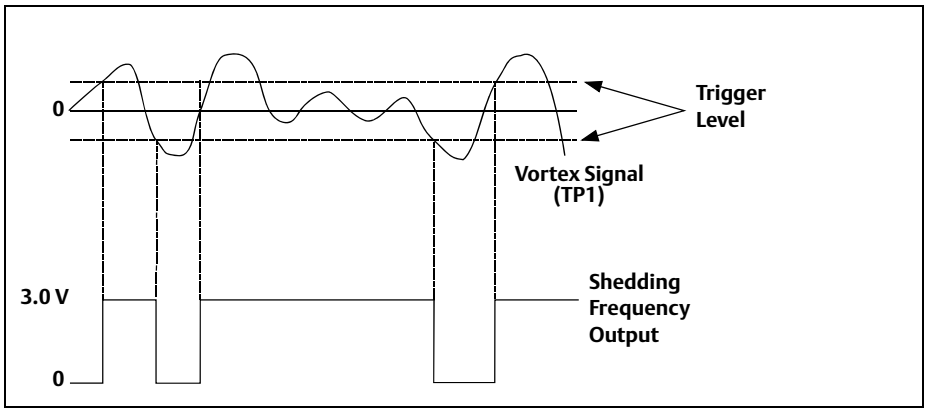


Figure 5-5. Improper Sizing/Filtering



5.4 Diagnostic messages on LCD

In addition to the output, the LCD indicator displays diagnostic messages for troubleshooting the flowmeter. These messages are as follows:

SELFTEST

The flowmeter is in the process of performing an electronics self test.

FAULT_ROM

The flowmeter electronics has undergone a EPROM checksum fault. Contact your Field Service Center.

FAULT_EEROM

The flowmeter electronics has undergone a EEPROM checksum fault. Contact your Field Service Center.

FAULT_RAM

The flowmeter electronics has undergone a RAM test fault.
Contact your Field Service Center.

FAULT_ASIC

The flowmeter electronics has undergone a digital signal processing ASIC update fault. Contact your Field Service Center.

FAULT_CONFG

The flowmeter electronics has lost critical configuration parameters. This message will be followed by information detailing the missing configuration parameters. Contact your Field Service Center.

FAULT_COPRO

The flowmeter electronics has detected a fault in the math coprocessor. Contact your Field Service Center.

FAULT_SFTWR

The flowmeter electronics has detected a non-recoverable fault in the software operation. Contact your Field Service Center.

FAULT_LOOPV

The flowmeter electronics has detected insufficient voltage to power the sensor board. Most likely the cause is low voltage at transmitter
4–20 mA terminals. Contact your Field Service Center.

FAULT_SDCOM

The flowmeter electronics has detected an unexpected sigma-delta ASIC communications fault. Contact your Field Service Center.

FAULT_SDPLS

The flowmeter electronics has detected a loss of flow data from the sigma-delta ASIC. Contact your Field Service Center.

FAULT_COEFF

The area of NV memory used to store the curve fit coefficients for the coprocessor calculation does not contain valid date. This date con only be loaded at the factory. Contact your Field Service Center.

FAULT_TACO (MTA option only)

The ASIC responsible for the analog to digital conversion of the process temperature has failed. Contact your Field Service Center.

FAULT_TC (MTA option only)

The temperature sensor that is used to measure the process temperature has failed. Contact your Field Service Center.

FAULT_RTD (MTA option only)

The RTD for cold junction compensation has failed. Contact your Field Service Center.

SIGNAL_SIMUL

The transmitter flow signal is being simulated by a signal generator internal to the transmitter. The actual flow through the meter body is NOT being measured.

SENSOR_OFFLINE

The transmitter flow signal is being simulated by a signal generator external to the transmitter. The actual flow through the meter body is NOT being measured.

FAULT_LOOPV

The voltage at the transmitter terminals has dropped to a level that is causing the internal voltage supplies to drop, reducing the capability of the transmitter to accurately measure a flow signal. Check the terminal voltage and either increase the power supply voltage or reduce loop resistance.

5.5 Testing procedures

Use the test functions to verify that the flowmeter is functioning properly, or when you suspect component failure or a problem with loop performance, or when instructed to do so as part of a troubleshooting procedure. Initiate each test with a HART-based communications device. See “Diagnostics/service” on page 47 for details.

5.6 Hardware replacement

The following procedures will help you disassemble and assemble the Rosemount 8600D hardware if you have followed the troubleshooting guide earlier in this section of the manual and determined that hardware components need to be replaced.

Note
Use only the procedures and new parts specifically referenced in this manual. Unauthorized procedures or parts can affect product performance and the output signal used to control a process, and may render the instrument dangerous.

Note
Flowmeters should not be left in service once they have been determined to be inoperable.

⚠ **Note**
Process should be vented before the meter body is removed from service for disassembly.

5.6.1 Replacing the terminal block in the housing

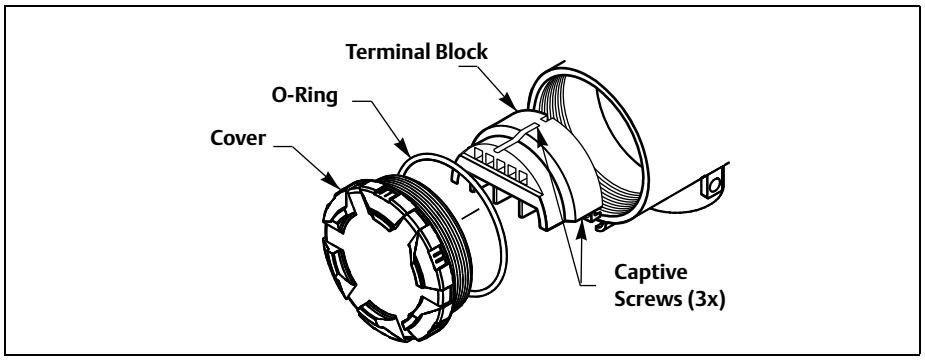
To replace the Field Terminal Block in the housing, you will need a small screwdriver. Use the following procedure to replace the terminal block in the housing of the Rosemount 8600D.

⚠ **Note**
Remove power before removing the electronics cover.

Remove the terminal block

1. Turn off the power to the Rosemount 8600D.
2. Unscrew the cover.

Figure 5-6. Terminal Block Assembly



3. Disconnect the wires from the field terminals. Be sure to secure them out of the way.
4. Remove the ground screw if transient protection (Option T1) is installed.
5. Loosen the three captive screws.
6. Pull outward on the terminal block to remove it from the housing.

⚠ See Safety Messages on page 67 for complete warning

Install the terminal block

1. Align the socketed holes on the back side of the terminal block over the pins protruding from the bottom of the housing cavity in the terminal block side of the electronics housing.
2. Slowly press the terminal block into place. Do not force the block into the housing. Check the screw alignment if it does not glide into place.
3. Tighten the three captive screws to anchor the terminal block.
4. Connect the wires to the appropriate field terminals.
5. Reinstall and tighten the transient ground screw if you have the transient option (Option T1).
6. Screw on and tighten the cover.

5.6.2 Replacing the electronics boards

The Rosemount 8600D electronics boards may need to be replaced if they have been damaged or otherwise become dysfunctional. Use the following procedures to replace electronics boards in the Rosemount 8600D. You will need a small Phillips head screwdriver and pliers.

Note
The electronics boards are electrostatically sensitive. Be sure to observe handling precautions for static-sensitive components.

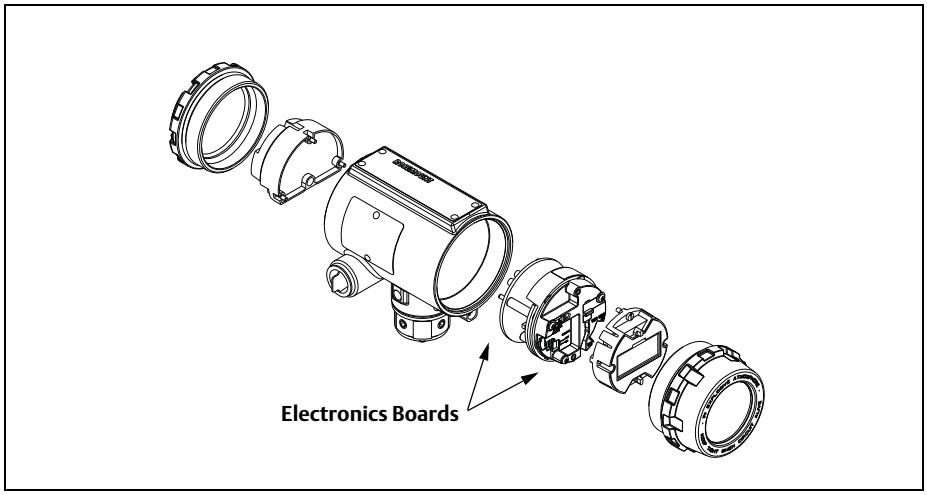
⚠ **Note**
Remove power before removing the electronics cover.

Remove the electronics boards

1. Turn off the power to the Rosemount 8600D.
2. Unscrew and remove the electronics board compartment cover. (Unscrew and remove the LCD cover if you have the LCD option).

⚠ See Safety Messages on page 67 for complete warning

Figure 5-7. Electronics Boards Assembly



3. If the meter has the LCD indicator option, loosen the two screws. Remove the LCD and the connector from the electronics board.
4. Loosen the three captive screws that anchor the electronics.
5. Use pliers or a flathead screwdriver to carefully remove the sensor cable clip from the electronics.
6. Remove thermocouple if MTA option installed.
7. Use the handle molded into the black plastic cover to slowly pull the electronics boards out of the housing.

Install the electronics boards

1. Verify that power to the Rosemount 8600D is off.
2. Align the sockets on the bottom of the two electronics boards over the pins protruding from the bottom of the housing cavity.
3. Carefully guide the sensor cable through the notches on the edge of the circuit boards.
4. Slowly press the boards into place. Do not force the boards down. Check the alignment if they do not glide into place.
5. Carefully insert sensor cable clip into electronics board.
6. Tighten the three captive screws to anchor the two electronics boards. Ensure that the SST washer is under the screw in the 2 o'clock position.
7. Reinsert jumpers into proper location.
8. If the meter has LCD option, insert the connector header into the LCD board.
   a. Remove jumpers from the electronics board.
   b. Put the connector through the bezel on the electronics board.
   c. Carefully press the LCD onto the electronics board.
   d. Tighten the two screws that retain the LCD indicator.
   e. Insert the alarm and security jumpers in the correct location.
9. Replace the electronics board compartment cover.

5.6.3 Replacing the electronics housing

The Rosemount 8600D electronics housing can be replaced easily when necessary. Use the following procedure:

Tools needed

- $^{5}/_{32}$-in. (4 mm) hex wrench
- $^{5}/_{16}$-in. (8 mm) open end wrench
- Screwdriver to disconnect wires
- Tools to disconnect conduit

Note
Remove power before removing the electronics housing.

See Safety Messages on page 67 for complete warning

Remove the electronics housing

1. Turn off the power to the Rosemount 8600D.
2. Remove the terminal block side cover.
3. Disconnect the wires and conduit from the housing.
4. Use a 5/32-in. (4 mm) hex wrench to loosen the housing rotation screws (at the base of the electronics housing) by turning screws clockwise (inward) until they clear the bracket.
5. Slowly pull the electronics housing no more than 1.5-in. (40 mm) from the top of the bracket.
6. Loosen the sensor cable nut from the housing with a 5/16-in. (8 mm) open end wrench.

Note
Lift the electronics housing until the sensor cable nut is exposed. Do not pull the housing more than 1.5-in. (40 mm) from the top of the bracket. Damage to the sensor may occur if this sensor cable is stressed.

Install the electronics housing

1. Verify that power to the Rosemount 8600D is off.
2. Screw the sensor cable nut onto the base of the housing.
3. Tighten the sensor cable nut with a 5/16-in. (8 mm) open end wrench.
4. Place the electronics housing into the top of the bracket.
5. Tighten the housing rotation screws with a hex 5/32-in. (4 mm) wrench.
6. Place the access cover on the bracket (if applicable).
7. Tighten the screw on the access cover.
8. Connect conduit and wires.
9. Replace the terminal block cover.
10. Apply power.

5.6.4 Replacing the sensor

The sensor for the Rosemount 8600D is a sensitive instrument that should not be removed unless there is a problem with it. If you must replace the sensor, follow these procedures closely. Please consult the factory before removing the sensor.

Note
Be sure to fully check all other troubleshooting possibilities before removing the sensor.

Also, please note that the sensor is a complete assembly and cannot be further disassembled.

Tools needed

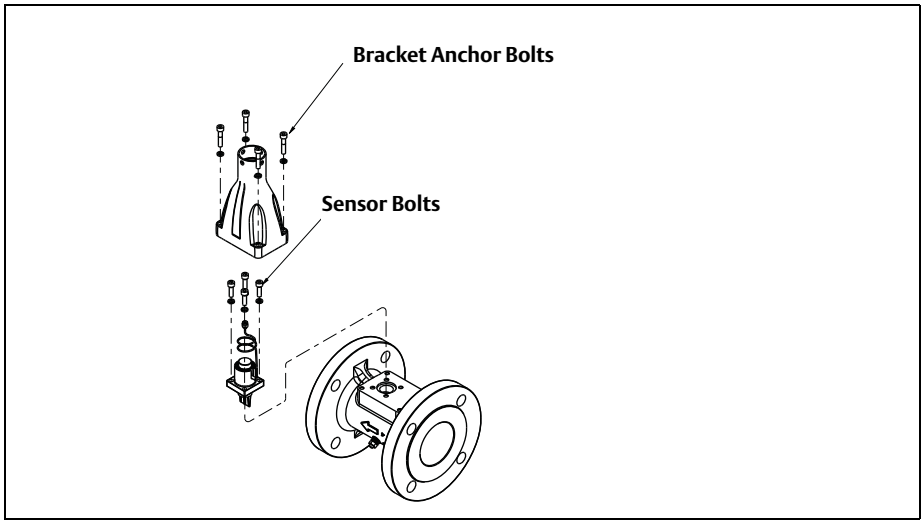
- 5/32-in. (4 mm) hex wrench
- 5/16-in. (8 mm) open end wrench
- 5 mm hex wrench
- Suction or compressed air device
- Small, soft bristle brush
- Cotton swabs
- Appropriate cleaning liquid: water or cleaning agent

1. De-pressurize the flow line.
2. Remove the electronics housing (see "Replacing the electronics housing" on page 79).

Removable bracket

3. Loosen the four bracket anchor bolts with a 5 mm hex wrench (See "Removable Bracket Assembly Figure 5-8).

Figure 5-8. Removable Bracket Assembly



4. Remove the bracket.
5. Loosen Sensor bolts with 5 mm hex wrench.
6. Remove sensor bolts, sensor, and gasket.

Cleaning the sealing surface

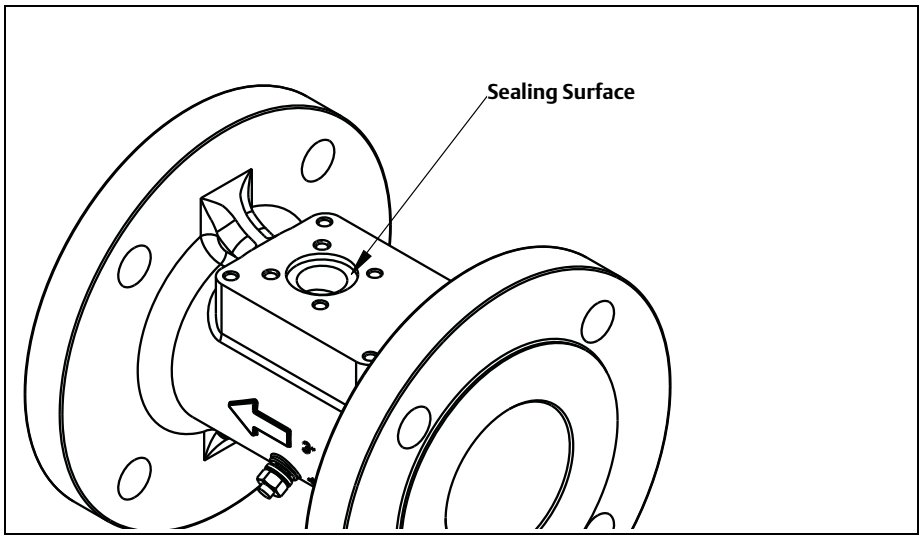
Before installing a sensor in the meter body, clean the sealing surface by completing the following procedure. The gaskets around the sensor are used to seal in the process fluid.

1. Use a suction or compressed air device to remove any loose particles from the sealing surface and other adjacent areas in the sensor.

Note
Do not scratch or deform any part of the sensor.

2. Carefully brush the sealing surface clean with a soft bristle brush.
3. Moisten a cotton swab with an appropriate cleaning liquid.
4. Wipe the sealing surface. Repeat several times if necessary with a clean cotton swab until there is minimal dirt residue picked up by the cotton swab.

Figure 5-9. Sensor Sealing Surface



5. Place new gasket on sealing surface.
6. Place new sensor on gasket.
7. Screw the sensor assembly in place. Tighten the bolts, in a crosswise sequence, with a 5 mm hex wrench to 70.8 in-lb (8 N-m).
8. Place the bracket into position.
9. Tighten the four bolts that anchor the bracket in place with a 5 mm hex wrench.
10. Install the flowmeter electronics housing. See Replacing the electronics housing on page 5-79.

5.6.5 Remote electronics procedure

If the Rosemount 8600D electronics housing is mounted remotely, some replacement procedures are different than for the flowmeter with integral electronics. The following procedures are exactly the same:

- Replacing the Terminal Block in the Housing (see page 76).
- Replacing the Electronics Boards (see page 77).
- Replacing the Sensor (see page 80).

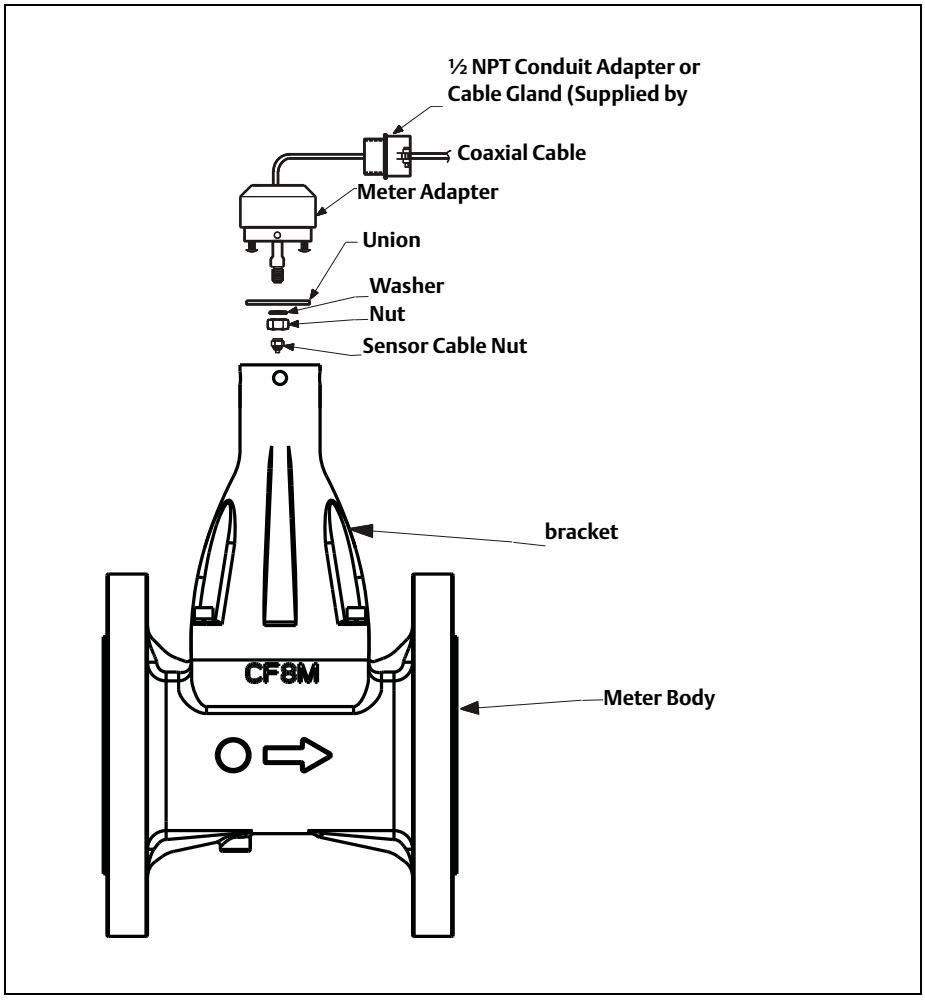
To disconnect the coaxial cable from the meter body and electronics housing, follow the instructions below.

Disconnect the coaxial cable at the meter

1. Remove the access cover on the meter body bracket if present.
2. Loosen the three housing rotation screws at the base of the meter adapter with a $^{5}/_{32}$-in. hex wrench by turning the screws clockwise (inward) until they clear the bracket.
3. Slowly pull the meter adapter no more than 1.5-in. (40 mm) from the top of the bracket.
4. Loosen and disconnect the sensor cable nut from the union using a $^{5}/_{16}$-in. open end wrench.

Note
Do not pull the adapter more than 1.5-in. (40 mm) from the top of the bracket. Damage to the sensor may occur if the sensor cable is stressed.

Figure 5-10. Coaxial Cable Connections



Detach the meter adapter

The above instructions will provide access to the meter body. Use the following steps if it is necessary to remove the coaxial cable:

1. Loosen and remove the two screws that hold the union onto the meter adapter and pull the union away from the adapter.

2. Loosen and remove the sensor cable nut from the other end of the union.

3. Loosen and disconnect the conduit adapter or cable gland from the meter adapter.

Attach the meter adapter

1. If you are using a conduit adapter or cable gland, slide it over the plain end of the coaxial cable (the end without a ground wire).
2. Slide the meter adapter over the coaxial cable end.
3. Use a $^{5}/_{16}$-in. (8 mm) open end wrench to securely tighten the sensor cable nut onto one end of the union.
4. Place the union onto the two screws extending out of the meter adapter and tighten the two screws.

Connect the coaxial cable at the meter body

1. Pull the sensor cable out of the bracket slightly and securely tighten the sensor cable nut onto the union.

Note
Do not stretch the sensor cable over 1.5-in. (40 mm) beyond the top of the bracket. Damage to the sensor may occur if the sensor cable is stressed.

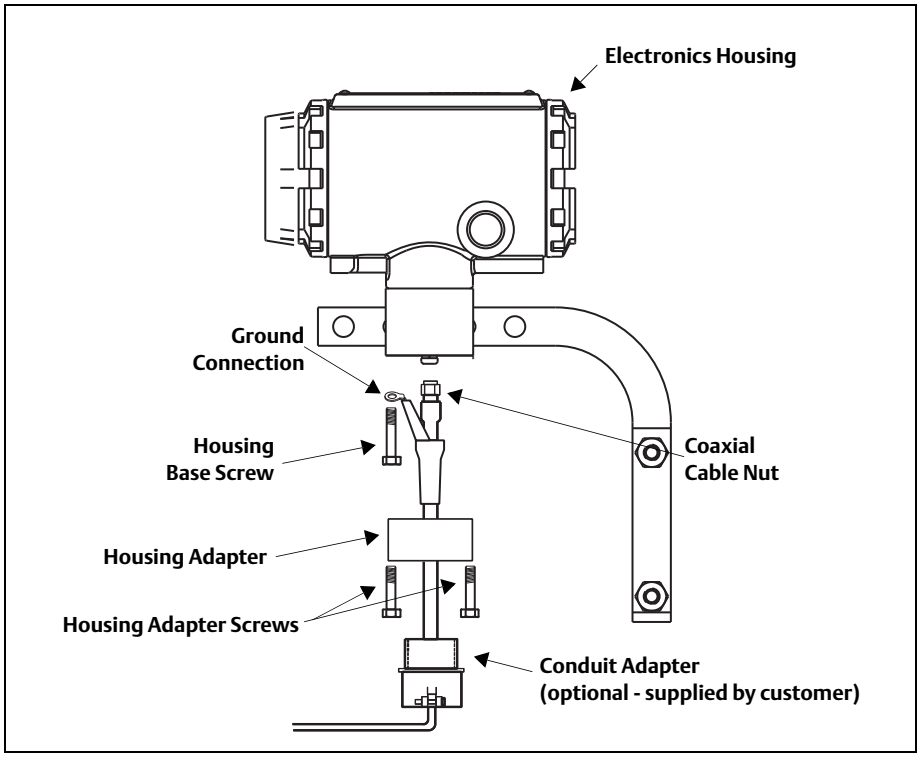
2. Place the meter adapter into the top of the bracket and line up the screw holes.
3. Use a hex wrench to turn the three adapter screws counterclockwise (outward) to engage the bracket.
4. Tighten the conduit adapter or cable gland into the meter adapter.

5.6.6 Coaxial cable at the electronics housing

Remove the coaxial cable from the electronics housing

1. Loosen the two housing screws from the housing adapter.
2. Remove the housing adapter from the housing.
3. Loosen and remove the coaxial cable nut from the base of the electronics housing.
4. Remove the coaxial cable ground connection from the housing base by loosening the housing base screw that is connecting it to the housing base.

Figure 5-11. Remote Electronics Exploded View



5. Loosen the conduit adapter (or cable gland) from the housing adapter.

Attach the coaxial cable

1. Route the coaxial cable through the conduit (if you are using conduit).
2. Place a conduit adapter over the end of the coaxial cable.
3. Remove the housing adapter from the electronics housing (if attached).
4. Slide the housing adapter over the coaxial cable.
5. Remove one of the four housing base screws that is in closest proximity to the ground connection.
6. Re-install the housing base screw by passing it through the ground connection.
7. Attach and securely tighten the coaxial cable nut to the connection on the electronics housing.
8. Align the housing adapter with the housing base and attach with the two housing adapter screws.
9. Tighten the conduit adapter to the housing adapter.

5.6.7 Changing the housing orientation

The entire electronics housing may be rotated in 90 degree increments for easy viewing. Use the following steps to change the housing orientation:

1. Loosen the screw on the access cover on the bracket (if present) and remove the cover.
2. Loosen the three housing rotation set screws at the base of the electronics housing with a 5/32-in. (4 mm) hex wrench by turning the screws clockwise (inward) until they clear the bracket.
3. Slowly pull the electronics housing out of the bracket.
4. Unscrew the sensor cable from the housing with a 5/16-in. open end wrench.

Note
Do not pull the housing more than 1.5-in. (40 mm) from the top of the bracket until the sensor cable is disconnected. Damage to the sensor may occur if this sensor cable is stressed.

5. Rotate the housing to the desired orientation.
6. Hold it in this orientation while you screw the sensor cable onto the base of the housing.

Note
Do not rotate the housing while the sensor cable is attached to the base of the housing. This will stress the cable and may damage the sensor.

7. Place the electronics housing into the top of the bracket.
8. Use a hex wrench to turn the four housing rotation screws counterclockwise to engage the bracket.

5.6.8 Temperature sensor replacement (MTA option only)

Replacement of the temperature sensor should only be necessary in the event of a failure. Use the following procedure for replacement.

Note
Disconnect power before replacing temperature sensor.

1. Turn off power to Rosemount 8600D.
2. Remove temperature sensor from meter body by using a 1/2-in. open end wrench. Refer to the procedure on page 81 to remove the bracket.

Note
Use plant approved procedure for removing a temperature sensor from a thermowell.

3. Remove temperature sensor from electronics by using a 2.5 mm allen wrench to remove cap head screw from electronics.
4. Gently pull temperature sensor from electronics.

Note
This will expose the electronics to the atmosphere.

5. Insert new temperature sensor into electronics housing using care to align pin and cap head screw to align connector pins.
6. Tightening cap head screw with 2.5 mm allen wrench.
7. Slide bolt and ferrule assembly onto temperature sensor and hold into place.
8. Insert temperature sensor into hole in the top of meter body until it reaches the bottom of the hole. Hold it in place and tighten bolt with $^{1}/_{2}$-in. open end wrench until $^{3}/_{4}$ turns past finger tight to seat ferrule.
9. Put the bracket back on, attach the four bolts, and tighten.
10. Reapply power to Rosemount 8600D.

5.7 Return of material

To expedite the return process, call the Rosemount North American Response Center at 800-654-RSMT (7768) toll-free number.
This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material to which the product was last exposed.

Caution
People who handle products exposed to a hazardous substance can avoid injury if they are informed and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

The Rosemount North American Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

Appendix A Reference data

Specifications . . . . . page 91
Functional specifications . . . . . page 91
Performance specifications . . . . . page 102
Physical specifications . . . . . page 105
Dimensional drawings . . . . . page 107

A.1 Specifications

The following specifications are for the Rosemount 8600D except where noted.

A.2 Functional specifications

Process fluids

Liquid, gas, and steam applications. Fluids must be homogeneous and single-phase.

Line sizes

Flanged style

1, 1 1/2, 2, 3, 4, 6, and 8 inches
(DN 25, 40, 50, 80, 100, 150, and 200)

Pipe schedules

Process piping Schedules 10, 40, 80, and 160.

Note
The appropriate bore diameter of the process piping must be entered using the Field Communicator or AMS Device Manager. Meters will be shipped from the factory at the Schedule 40 default value unless otherwise specified.

Measurable flow rates

Capable of processing signals from flow applications which meet the sizing requirements below.

To determine the appropriate flowmeter size for an application, process conditions must be within the Reynolds number and velocity limitations for the desired line size provided in Table A-1, Table A-2, and Table A-3.

Note
Consult your local sales representative to obtain a computer sizing program that describes in greater detail how to specify the correct flowmeter size for an application.

The Reynolds number equation shown below combines the effects of density (ρ), viscosity (μ_{cp}), pipe inside diameter (D), and flow velocity (V).

$$R_D = \frac{VD\rho}{\mu_{cp}}$$

Table A-1. Minimum Measurable Meter Reynolds Numbers

Meter Sizes (Inches / DN)	Reynolds Number Limitations
1 through 4/25 through 100	5000 minimum
6 through 8/150 through 200	

Table A-2. Minimum Measurable Meter Velocities(1)

	Feet per Second	Meters per Second
Liquids	$\sqrt{36/\rho}$	$\sqrt{54/\rho}$
Gases	$\sqrt{36/\rho}$	$\sqrt{54/\rho}$
The ρ is the process fluid density at flowing conditions in lb/ft³ for ft/s and kg/m³ for m/s		

(1) Velocities are referenced to schedule 40 pipe.

Table A-3. Maximum Measurable Meter Velocities(1) (Use the smaller of the two values)

	Feet per Second	Meters per Second
Liquids	$\sqrt{90{,}000/\rho}$ or 25	$\sqrt{134{,}000/\rho}$ or 7.6
Gases	$\sqrt{90{,}000/\rho}$ or 250	$\sqrt{134{,}000/\rho}$ or 76
The ρ is the process fluid density at flowing conditions in lb/ft³ for ft/s and kg/m³ for m/s		

(1) Velocities are referenced to schedule 40 pipe.

Process temperature limits

Standard

-58 to 482 °F (–50 to 250 °C)

Output signals

4–20 mA digital HART signal

Superimposed on 4–20 mA signal

Optional scalable pulse output

0 to 10000 Hz; transistor switch closure with adjustable scaling via HART communications; capable of switching up to 30 Vdc, 120 mA maximum.

Analog output adjustment

Engineering units and lower and upper range values are user-selected. Output is automatically scaled to provide 4 mA at the selected lower range value, 20 mA at the selected upper range value. No frequency input is required to adjust the range values.

Scalable frequency adjustment

The scalable pulse output can be set to a specific velocity, volume, or mass (i.e. 1 pulse = 1 lb). The scalable pulse output can also be scaled to a specific rate of volume, mass, or velocity (i.e. 100 Hz = 500 lb/hr).

Ambient temperature limits

Operating

–58 to 185 °F (–50 to 85 °C)
–4 to 185 °F (–20 to 85 °C) for flowmeters with local indicator

Storage

–58 to 250 °F (–50 to 121 °C)
–50 to 185 °F (–46 to 85 °C) for flowmeters with local indicator

Pressure limits

Flange style meter

Rated for ASME B16.5 (ANSI) Class 150, 300, EN 1092 PN 16, 40, and 63

Power supply

HART analog

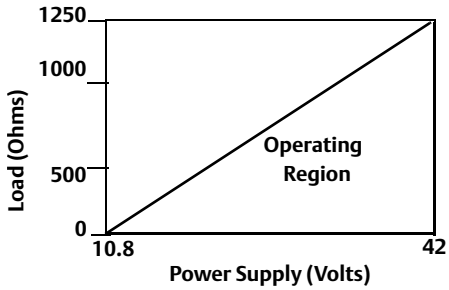
External power supply required. Flowmeter operates on 10.8 to 42 Vdc terminal voltage (with 250-ohm minimum load required for HART communications, 16.8 Vdc power supply is required)

Power consumption

One watt maximum

Load limitations (HART analog)

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:



$R_{max} =$ $41.7(V_{ps} - 10.8)$
$V_{ps} =$ Power Supply Voltage (Volts)
$R_{max} =$ Maximum Loop Resistance (Ohms)

Note
HART Communication requires a minimum loop resistance of 250 ohms.

Optional LCD indicator

The optional LCD indicator is capable of displaying:

- Primary Variable
- Velocity Flow
- Volumetric Flow
- Mass Flow
- Percent of Range
- Analog Output
- Totalizer
- Shedding Frequency
- Pulse Output Frequency (if applicable)
- Electronics Temperature
- Process Temperature (MTA Option Only)
- Calculated Process Density (MTA Option Only)

If more than one item is selected, the display will scroll through all items selected.

Enclosure rating

FM Type 4X; IP66

Permanent pressure loss

The approximate permanent pressure loss (PPL) from the Rosemount 8600D flowmeter is calculated for each application in the Vortex sizing software available from your local Rosemount representative. The PPL is determined using the equation:

$$PPL = \frac{A \times \rho_f \times Q^2}{D^4}$$

where:

PPL = Permanent Pressure loss (psi or kPa)
Where:

ρ_f = Density at operating conditions (lb/ft^3 or kg/m^3)

Q = Actual volumetric flow rate (Gas = ft^3/min or m^3/hr; Liquid = gal/min or l/min)

D = Flowmeter bore diameter (in. or mm)

A = Constant depending on meter style, fluid type and flow units. Determined per following table:

Table A-4. Determining the PPL

Meter Style	English Units		SI Units	
	A_{Liquid}	A_{Gas}	A_{Liquid}	A_{Gas}
8600DF	3.4×10^{-5}	1.9×10^{-3}	0.425	118

Minimum upstream pressure (Liquids)

Flow metering conditions that would allow cavitation, the release of vapor from a liquid, should be avoided. This flow condition can be avoided by remaining within the proper flow range of the meter and by following appropriate system design.

For some liquid applications, incorporation of a back pressure valve should be considered. To prevent cavitation, the minimum upstream pressure should be:

P = $2.9*\Delta P + 1.3*p_v$ or P = $2.9*\Delta P + p_v + 0.5$ psia (3.45 kPa) (use the smaller of the two results)

P = Line pressure five pipe diameters downstream of the meter (psia or kPa abs)

ΔP = Pressure loss across the meter (psi or kPa)

p_v = Liquid vapor pressure at operating conditions (psia or kPa abs)

Failure mode alarm

HART analog

If self-diagnostics detect a gross flowmeter failure, the analog signal will be driven to the values below:

Low	3.75
High	21.75
NAMUR Low	3.60
NAMUR High	22.6

High or low alarm signal is user-selectable through the fail mode alarm jumper on the electronics. NAMUR-compliant alarm limits are available through the C4 or CN Option. Alarm type is field configurable also.

Saturation output values

When the operating flow is outside the range points, the analog output continues to track the operating flow until reaching the saturation value listed below; the output does not exceed the listed saturation value regardless of the operating flow. The NAMUR-Compliant Saturation Values are available through the C4 or CN option. Saturation type is field configurable.

Low	3.9
High	20.8
NAMUR Low	3.8
NAMUR High	20.5

Damping

Flow Damping adjustable between 0.2 and 255 seconds.

Process Temperature Damping adjustable between 0.4 and 32 seconds (MTA Option Only).

Response time

Three vortex shedding cycles or 300 ms, whichever is greater, maximum required to reach 63.2% of actual input with the minimum damping (0.2 seconds).

Turn-on time

HART analog

Less than four (4) seconds plus the response time to rated accuracy from power up (less than 7 seconds with the MTA Option).

Transient protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

The transient terminal block meets the following specifications:
IEEE C62.41 - 2002 Category B

3 kA crest (8 × 20 μs)
6 kV crest (1.2 × 50 μs)
6 kV/0.5 kA (0.5 μs, 100 kHz, ring wave)

Security lockout

When the security lockout jumper is enabled, the electronics will not allow you to modify parameters that affect flowmeter output.

Output testing

Current source

Flowmeter may be commanded to set the current to a specified value between 4 and 20 mA.

Frequency source

Flowmeter may be commanded to set the frequency to a specified value between 0 and 10000 Hz.

Low flow cutoff

Adjustable over entire flow range. Below selected value, output is driven to 4 mA and zero pulse output frequency.

Humidity limits

Operates in 0–95% relative humidity under non-condensing conditions (tested to IEC 60770, Section 6.2.11).

Overrange capability

HART analog

Analog signal output continues to 105 percent of span, then remains constant with increasing flow. The digital and pulse outputs will continue to indicate flow up to the upper sensor limit of the flowmeter and a maximum pulse output frequency of 10400 Hz.

Flow calibration

Meter bodies are flow-calibrated and assigned a unique calibration factor (K-factor) at the factory. The calibration factor is entered into the electronics, enabling interchangeability of electronics and/or sensors without calculations or compromise in accuracy of the calibrated meter body.

A.3 Typical flow ranges

Table A-5 - Table A-9 show typical flow ranges for some common process fluids with default filter settings. Consult your local sales representative to obtain a computer sizing program that describes in greater detail the flow range for an application.

Table A-5. Typical pipe velocity ranges for 8600D(1)

Process Line Size		Liquid Velocity Ranges		Gas Velocity Ranges	
(Inches/ DN)	Vortex Meter	(ft/s)	(m/s)	(ft/s)	(m/s)
1/ 25	8600DF010	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
1 1/2 / 40	8600DF015	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
2/ 50	8600DF020	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
3/ 80	8600DF030	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
4/ 100	8600DF040	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
6/ 150	8600DF060	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
8/ 200	8600DF080	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2

(1) Table A-5 is a reference of pipe velocities that can be measured for the standard Rosemount 8600D. It does not consider density limitations, as described in Table A-2 and Table A-3. Velocities are referenced in schedule 40 pipe.

Table A-6. Water Flow Rate Limits for the Rosemount 8600D(1)

Process Line Size		Minimum and Maximum Measurable Water Flow Rates*	
(Inches/ DN)	Vortex Meter	Gallons/Minute	Cubic Meters/Hour
1/ 25	8600DF010	2.96 to 67.3	0.67 to 15.3
1 1/2 / 40	8600DF015	4.83 to 158	1.10 to 35.9
2/ 50	8600DF020	7.96 to 261	1.81 to 59.4
3/ 80	8600DF030	17.5 to 576	4.00 to 130
4/ 100	8600DF040	30.2 to 992	6.86 to 225
6/ 150	8600DF060	68.5 to 2251	15.6 to 511
8/ 200	8600DF080	119 to 3898	27.0 to 885
***Conditions: 77 °F (25 °C) and 14.7 psia (1.01 bar absolute)**			

(1) Table A-6 is a reference of flow rates that can be measured for the standard Rosemount 8600D. It does not consider density limitations, as described in Table A-2 and Table A-3.

Table A-7. Air Flow Rate Limits at 59 °F (15 °C)

Process Pressure	Flow Rate Limits	Minimum and Maximum Air Flow Rates for line sizes 1-in./DN 25 through 2-in./DN 50					
		1-in./DN 25		1 1/2-in./DN 40		2-in./DN 50	
		Rosemount 8600D		Rosemount 8600D		Rosemount 8600D	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	79.2	134	212	360	349	593
	min	9.71	16.5	18.4	31.2	30.3	51.5
50 psig (3,45 bar G)	max	79.2	134	212	360	349	593
	min	3.72	6.32	8.76	14.9	14.5	24.6
100 psig (6,89 bar G)	max	79.2	134	212	360	349	593
	min	2.80	4.75	6.58	11.2	10.8	18.3
150 psig (10,3 bar G)	max	79.2	134	212	360	349	593
	min	2.34	3.98	5.51	9.36	9.09	15.4

Table A-7. Air Flow Rate Limits at 59 °F (15 °C)

200 psig (13,8 bar G)	max min	79.2 2.34	134 3.98	212 5.51	360 9.36	349 9.09	593 15.4
300 psig (20,7 bar G)	max min	79.2 2.34	134 3.98	198 5.51	337 9.36	326 9.09	554 15.4
400 psig (27,6 bar G)	max min	73.0 2.34	124 3.98	172 5.51	293 9.36	284 9.09	483 15.4
500 psig (34,5 bar G)	max min	66.0 2.34	112 3.98	154 5.51	262 9.36	254 9.09	432 15.4

Table A-8. Air Flow Rate Limits at 59 °F (15 °C)

Process Pressure	Flow Rate Limits	Minimum and Maximum Air Flow Rates for line sizes 3-in./DN 80 through 4-in./DN 100			
		3-in./DN 80		4-in./DN 100	
		Rosemount 8600D		Rosemount 8600D	
		ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max min	770 66.8	1308 114	1326 115	2253 195
50 psig (3,45 bar G)	max min	770 31.8	1308 54.1	1326 54.8	2253 93.2
100 psig (6,89 bar G)	max min	770 23.9	1308 40.6	1326 41.1	2253 69.8
150 psig (10,3 bar G)	max min	770 20.0	1308 34.0	1326 34.5	2253 58.6
200 psig (13,8 bar G)	max min	770 20.0	1308 34.0	1326 34.5	2253 58.6
300 psig (20,7 bar G)	max min	718 20.0	1220 34.0	1237 34.5	2102 58.6
400 psig (27,6 bar G)	max min	625 20.0	1062 34.0	1076 34.5	1828 58.6
500 psig (34,5 bar G)	max min	560 20.0	951 34.0	964 34.5	1638 58.6

Table A-9. Air Flow Rate Limits at 59 °F (15 °C)

Process Pressure	Flow Rate Limits	Minimum and Maximum Air Flow Rates for line sizes 6-in./DN 150 through 8-in./DN 200			
		6-in./DN 150		8-in./DN 200	
		Rosemount 8600D		Rosemount 8600D	
		ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max min	3009 261	5112 443	5211 452	8853 768
50 psig (3,45 bar G)	max min	3009 124	5112 211	5211 215	8853 365
100 psig (6,89 bar G)	max min	3009 93.3	5112 159	5211 162	8853 276
150 psig (10,3 bar G)	max min	3009 78.2	5112 133	5211 135	8853 229
200 psig (13,8 bar G)	max min	3009 78.2	5112 133	5211 135	8853 229
300 psig (20,7 bar G)	max min	2807 78.2	4769 133	4862 135	8260 229

Table A-9. Air Flow Rate Limits at 59 °F (15 °C)

400 psig (27,6 bar G)	max min	2442 78.2	4149 133	4228 136	7183 229
500 psig (34,5 bar G)	max min	2188 78.2	3717 133	3789 136	6437 229

Notes

The Rosemount 8600D measures the volumetric flow under operating conditions (i.e. the actual volume at the operating pressure and temperature–acfm or acmh), as shown above. However, gas volumes are strongly dependent on pressure and temperature. Therefore, gas quantities are typically stated in standard or normal conditions (e.g. SCFM or NCMH). (Standard conditions are typically 59 °F and 14.7 psia. Normal conditions are typically 0 °C and 1 bar abs.)
The flow rate limits in standard conditions are found using the equations below:
Standard Flow Rate = Actual Flow Rate X Density Ratio
Density Ratio = Density at Actual (Operating) Conditions / Density at Standard Conditions

Table A-10. Saturated Steam Flow Rate Limits (Assumes Steam Quality is 100%)

Process Pressure	Flow Rate Limits	Minimum and Maximum Saturated Steam Flow Rates for line sizes 1-in./DN 25 through 2-in./DN 50					
		1-in./DN 25		1 1/2-in./DN 40		2-in./DN 50	
		Rosemount 8600D		Rosemount 8600D		Rosemount 8600D	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max min	342 34.8	155 15.8	917 82.0	416 37.2	1511 135	685 61.2
25 psig (1,72 bar G)	max min	449 39.9	203 18.1	1204 93.9	546 42.6	1983 155	899 70.2
50 psig (3,45 bar G)	max min	711 50.1	322 22.7	1904 118	864 53.4	3138 195	1423 88.3
100 psig (6,89 bar G)	max min	1221 65.7	554 29.8	3270 155	1483 70.1	5389 255	2444 116
150 psig (10,3 bar G)	max min	1724 78.1	782 35.4	4616 184	2094 83.2	7609 303	3451 137
200 psig (13,8 bar G)	max min	2225 88.7	1009 40.2	5956 209	2702 94.5	9818 344	4453 156
300 psig (20,7 bar G)	max min	3229 107	1464 48.5	8644 252	3921 114	14248 415	6463 189
400 psig (27,6 bar G)	max min	4244 125	1925 56.7	11362 295	5154 134	18727 487	8494 221
500 psig (34,5 bar G)	max min	5277 156	2393 70.7	14126 367	6407 167	23284 605	10561 274

Table A-11. Saturated Steam Flow Rate Limits (Assumes Steam Quality is 100%)

Process Pressure	Flow Rate Limits	Minimum and Maximum Saturated Steam Flow Rates for line sizes 3-in./DN 80 through 4-in./DN 100			
		3-in./DN 80		4-in./DN 100	
		Rosemount 8600D		Rosemount 8600D	
		lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max min	3330 298	1510 135	5734 513	2601 233
25 psig (1,72 bar G)	max min	4370 341	1982 155	7526 587	3414 267
50 psig (3,45 bar G)	max min	6914 429	3136 195	11905 739	5400 335
100 psig (6,89 bar G)	max min	11874 562	5386 255	20448 968	9275 439
150 psig (10,3 bar G)	max min	16763 668	7603 303	28866 1150	13093 522
200 psig (13,8 bar G)	max min	21630 759	9811 344	37247 1307	16895 593
300 psig (20,7 bar G)	max min	31389 914	14237 415	54052 1574	24517 714
400 psig (27,6 bar G)	max min	41258 1073	18714 487	71047 1847	32226 838
500 psig (34,5 bar G)	max min	51297 1334	23267 605	88334 2297	40068 1042

Table A-12. Saturated Steam Flow Rate Limits (Assumes Steam Quality is 100%)

Process Pressure	Flow Rate Limits	Minimum and Maximum Saturated Steam Flow Rates for line sizes 6-in./DN 150 through 8-in./DN 200			
		6-in./DN 150		8-in./DN 200	
		Rosemount 8600D		Rosemount 8600D	
		lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max min	13013 1163	5903 528	22534 2015	10221 914
25 psig (1,72 bar G)	max min	17080 1333	7747 605	29575 2308	13415 1047
50 psig (3,45 bar G)	max min	27019 1676	12255 760	46787 2903	21222 1317
100 psig (6,89 bar G)	max min	46405 2197	21049 996	80356 3804	36449 1725
150 psig (10,3 bar G)	max min	65611 2610	29761 1184	113440 4520	51455 2050
200 psig (13,8 bar G)	max min	84530 2965	38342 1345	146375 5134	66395 2329
300 psig (20,7 bar G)	max min	122666 3572	55640 1620	212411 6185	96348 2805
400 psig (27,6 bar G)	max min	161236 4192	73135 1901	279200 7259	126643 3293
500 psig (34,5 bar G)	max min	200468 5212	90931 2364	347134 9025	157457 4094

A.4 Performance specifications

The following performance specifications are for all Rosemount models except where noted. Digital performance specifications applicable to Digital HART output.

A.4.1 Flow accuracy

Includes linearity, hysteresis, and repeatability.

Liquids - for Reynolds Numbers over 20,000

Digital and pulse output

± 0.75% of rate

Analog output

Same as pulse output plus an additional 0.025% of span

Gas and steam - for Reynolds Numbers over 15,000

Digital and pulse output

± 1% of rate

Analog output

Same as pulse output plus an additional 0.025% of span

Accuracy limitations for gas and steam:

Max velocity of 100 ft/s (30.5 m/s)

Note
As the meter Reynolds Numbers decreases below the stated limit to 10,000 the accuracy error band will increase linearly to +/-3.0%. For Reynolds Numbers down to 5,000 the accuracy error band will increase linearly from +/-3.0% to +/-10.0%.

Process temperature accuracy

2.2 °F (1.2 °C).

Note
For remote mount installations, add ±0.018 °F/ft. (±0.03 °C/m) of uncertainty to the temperature measurement.

Mass flow accuracy for temperature compensated mass flow

Digital and pulse output

± 2.5% of rate (Nominal)

Nominal conditions include temperature variation in saturation and superheat at 150 psig (10 bar-g) and above.

For pressure below 150 psig (10 bar-g), add 0.08% of uncertainty for every 15 psi (1 bar) below 150 psig (10 bar-g).

Analog output

Same as pulse output plus an additional 0.025% of span

Repeatability

± 0.2% of actual flow rate

Stability

± 0.1% of rate over one year

Process temperature effect

Automatic K-factor correction with user-entered process temperature.

Table A-13 indicates the percent change in K-factor per 100 °F (55.5 °C) in process temperature from reference temperature of 77 °F (25 °C).

Table A-13. Process Temperature Effect

Percent Change in K-Factor per 100 °F (55.5 °C)	
< 77 °F (25 °C)	+ 0.23
> 77 °F (25 °C)	- 0.27

Ambient temperature effect

Digital and pulse outputs

No effect

Analog output

±0.1% of span from –58 to 185 °F (–50 to 85 °C)

Vibration effect

An output with no process flow may be detected if sufficiently high vibration is present.

The meter design will minimize this effect, and the factory settings for signal processing are selected to eliminate these errors for most applications.

If an output error at zero flow is still detected, it can be eliminated by adjusting the low flow cutoff, trigger level, or low-pass filter.

As the process begins to flow through the meter, most vibration effects are quickly overcome by the flow signal.

Vibration specifications

Integral aluminum housings and remote aluminum housings

At or near the minimum liquid flow rate in a normal pipe mounted installation, the maximum vibration should be 0.087-in. (2,21 mm) double amplitude displacement or 1 g acceleration, whichever is smaller. At or near the minimum gas flow rate in a normal pipe mounted installation, the maximum vibration should be 0.043-in. (1,09 mm) double amplitude displacement or $^1/_2$ g acceleration, whichever is smaller.

Mounting position effect

Meter will meet accuracy specifications when mounted in horizontal, vertical, or inclined pipelines. Best practice for mounting in a horizontal pipe is to orient the shedder bar in the horizontal plane. This will prevent solids in liquid applications and liquid in gas/steam applications from disrupting the shedding frequency.

EMI/RFI effect

Meets EMC requirements to EU Directive 2004/108/EC.

HART analog

Output error less than ±0.025% of span with twisted pair from 80-1000 MHz for radiated field strength of 10 V/m; 1.4 - 2.0 GHz for radiated field strength of 3 V/m; 2.0 - 2.7 GHz for radiated field strength of 1 V/m. Tested per EN61326.

Digital HART

No effect on the values that are being given if using HART digital signal.
Tested per EN61326.

Magnetic-field interference

HART analog

Output error less than ±0.025% of span at
30 A/m (rms). Tested per EN61326.

Series mode noise rejection

HART analog

Output error less than ±0.025% of span at
1 V rms, 60 Hz.

Common mode noise rejection

HART analog

Output error less than ±0.025% of span at 30 V rms, 60 Hz.

Power supply effect

HART analog

Less than 0.005% of span per volt

A.5 Physical specifications

NACE compliance

Materials of Construction meet NACE material recommendations per MR0175/ISO15156 for use in H_2S containing environments in oil field production. Materials of construction also meet NACE recommendations per MR0103-2003 for corrosive petroleum refining environments. MR0103 compliance requires Q25 option in model code.

Note
Certificate of compliance for MR0175/ISO15156 requires Q15 as a separate line item.

Electrical connections

$^1/_2$ –14 NPT or M20 × 1.5 conduit threads; screw terminals provided for 4–20 mA and pulse output connections; communicator connections permanently fixed to terminal block.

Non-wetted materials

Housing

Low-copper aluminum (FM Type 4X, CSA Type 4X, IP66)

Paint

Polyurethane

Cover O-rings

Buna-N

Temperature sensor (MTA option)

Type-N Thermocouple

Process-wetted materials

Meter body

CF-8M cast stainless.

Sensor material

CF-3M cast stainless.

Gasket

Graphite with Stainless Steel Insert

Process connections

Mounts between the following flange configurations:

ASME B16.5 (ANSI): Class 150, 300

EN 1092: PN 16, 40, 63

Mounting

Integral (standard)

Electronics are mounted on meter body.

Remote (optional)

Electronics may be mounted remote from the meter body. Interconnecting coaxial cable available in nonadjustable 10, 20, and 30 ft (3,0, 6,1, and 9,1 m) lengths. Consult factory for non-standard lengths up to 75 ft (22,9 m). Remote mounting hardware includes a pipe mount bracket with one u-bolt.

Temperature limitations for integral mounting

The maximum process temperature for integral mount electronics is dependent on the ambient temperature where the meter is installed. The electronics must not exceed 185 °F (85 °C).

Pipe length requirements

The vortex meter may be installed with a minimum of ten diameters (D) of straight pipe length upstream and five diameters (D) of straight pipe length downstream.

Rated Accuracy is based on the number of pipe diameter from an upstream disturbance. No K-factor correction is required if the meter is installed with 35 D upstream and 10 D downstream.

Tagging

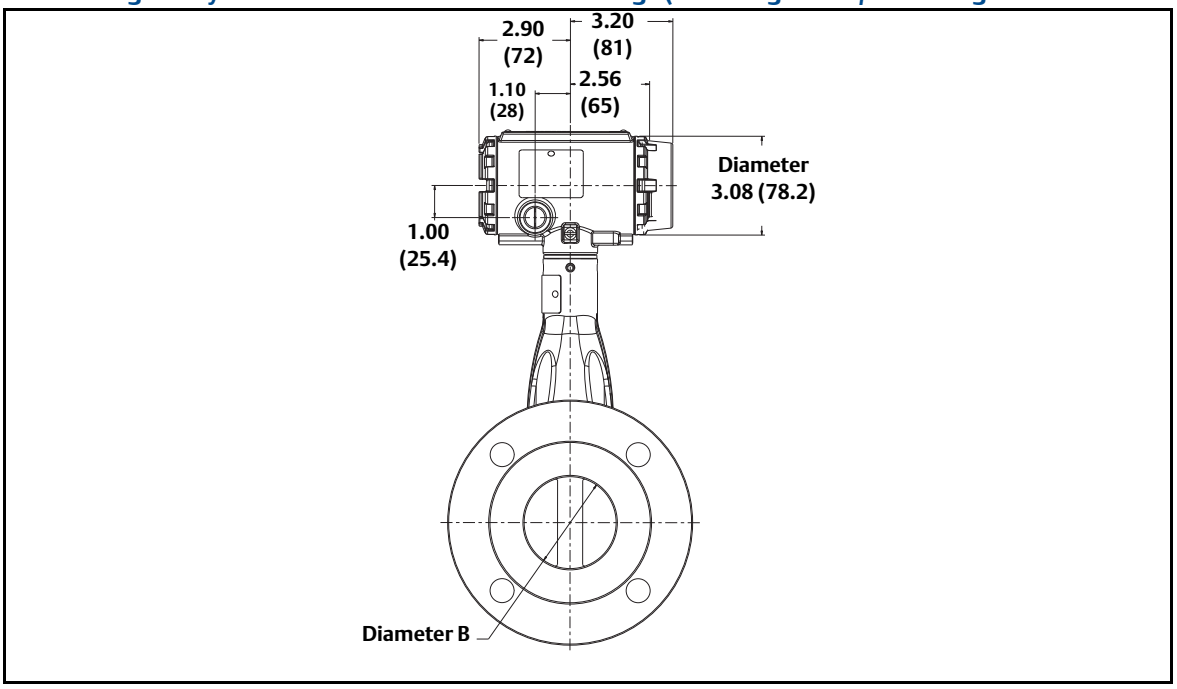
The flowmeter will be tagged at no charge, according to customer requirements. All tags are stainless steel. The standard tag is permanently attached to the flowmeter. Character height is 1/16-in. (1,6 mm). A wired-on tag is available on request. Wire on tags can contain five lines with up to 28 characters per line.

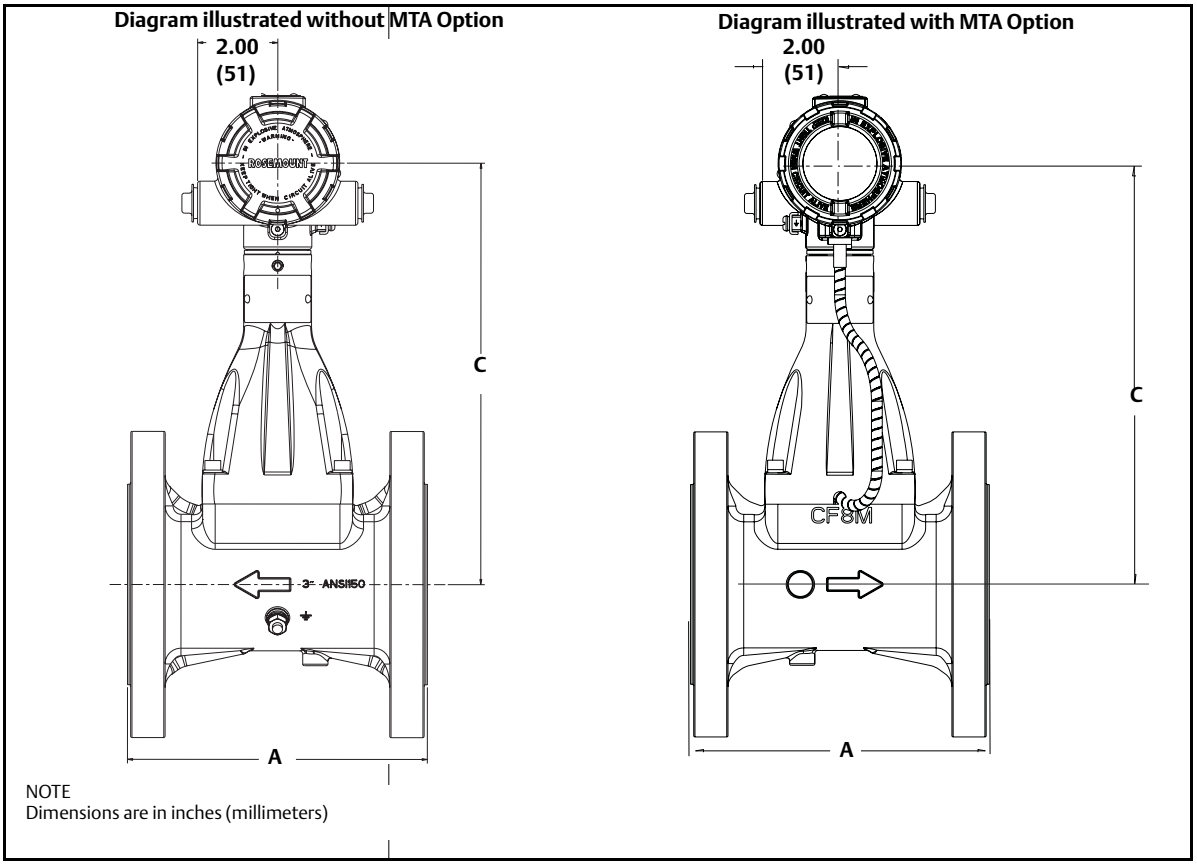
Flow calibration information

Flowmeter calibration and configuration information is provided with every flowmeter. For a certified copy of flow calibration data, Option Q4 must be ordered in the model number.

A.6 Dimensional drawings

Figure A-1. Flanged-Style Flowmeter Dimensional Drawings (1-through 8-in./25 through 200 mm Line Sizes)





NOTE
Dimensions are in inches (millimeters)

Table A-14. Flanged-Style Flowmeter (1-through 2-in./25 through 50 mm Line Sizes)

Nominal Size in. (mm)	Flange Rating	Face-to-face A in. (mm)	Diameter B in. (mm)	C in. (mm)	Weight(1) lb (kg)
1 (25)	ANSI 150 ANSI 300	5.9 (150) 6.7 (170)	0.95 (24,1) 0.95 (24,1)	9.8 (250) 9.8 (250)	12.3 (5,6) 15.0 (6,8)
	PN 16/40	6.1 (156)	0.95 (24,1)	9.8 (250)	13.6 (6,2)
1 1/2 (40)	ANSI 150 ANSI 300	5.9 (150) 7.1 (180)	1.49 (37,8) 1.49 (37,8)	10.0 (253) 10.0 (253)	17.6 (8,0) 23.0 (10,5)
	PN 16/40	7.1 (180)	1.49 (37,8)	10.0 (253)	19.4 (8,8)
2 (50)	ANSI 150 ANSI 300	6.7 (170) 7.1 (180)	1.92 (48,8) 1.92 (48,8)	10.2 (260) 10.2 (260)	22.0 (10,1) 26.1 (11,8)
	PN 16/40	6.7 (170)	1.92 (48,8)	10.2 (260)	23.2 (10,5)

(1) Add 0.2 lb (0,1 kg) for display option.

Table A-15. Flanged-Style Flowmeter (3-through 6-in./80 through 150 mm Line Sizes) (Refer to previous drawing)

Nominal Size in. (mm)	Flange Rating	Face-to-face A in. (mm)	Diameter B in. (mm)	C in. (mm)	Weight(1) lb (kg)
3 (80)	ANSI 150 ANSI 300	7.5 (190) 8.8 (224)	2.87 (72,9) 2.87 (72,9)	10.7 (273) 10.7 (273)	37.2 (16,9) 46.5 (21,1)
	PN 16/40	7.9 (200)	2.87 (72,9)	10.7 (273)	36.6 (16,6)
4 (100)	ANSI 150 ANSI 300	7.5 (190) 8.7 (220)	3.79 (96,3) 3.79 (96,3)	11.2 (285) 11.2 (285)	51.3 (23,3) 71.5 (32,4)
	PN 16 PN 40	7.5 (190) 8.7 (220)	3.79 (96,3) 3.79 (96,3)	11.2 (285) 11.2 (285)	40.4 (18,2) 49.5 (22,4)
6 (150)	ANSI 150 ANSI 300	9.8 (250) 10.6 (270)	5.7 (144,8) 5.7 (144,8)	12.3 (312) 12.3 (312)	81 (37) 120 (55)
	PN 16 PN 40	9.8 (250) 10.6 (270)	5.7 (144,8) 5.7 (144,8)	12.3 (312) 12.3 (312)	66 (30) 86 (39)

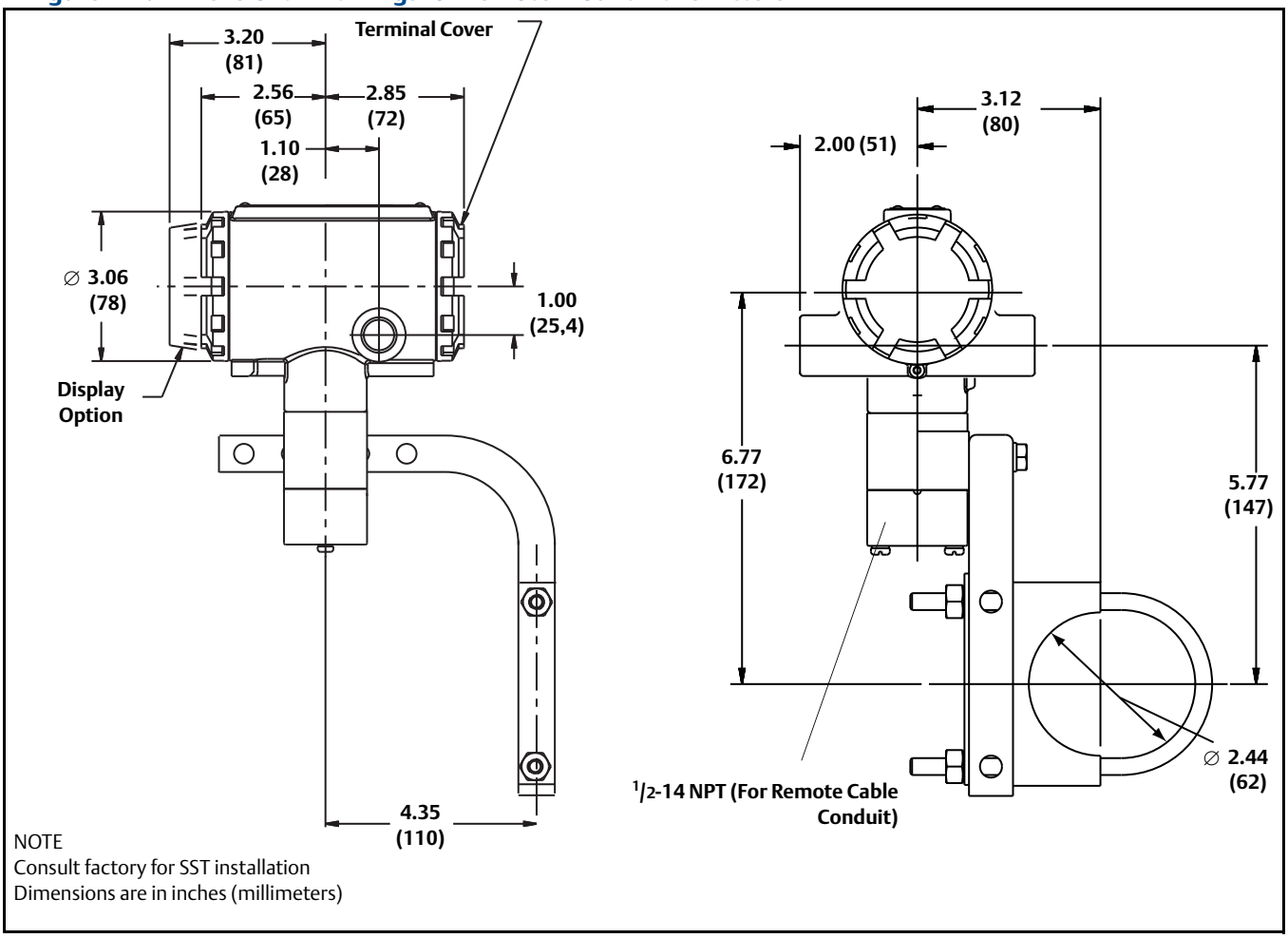
(1) Add 0.2 lb (0,1 kg) for display option.

Table A-16. Flanged-Style Flowmeter (8-in./200 mm Line Sizes) (Refer to previous drawing)

Nominal Size in. (mm)	Flange Rating	Face-to-face A in. (mm)	Diameter B in. (mm)	C in. (mm)	Weight(1) lb (kg)
8 (200)	ANSI 150 ANSI 300	9.8 (250) 11.4 (290)	7.55 (191,8) 7.55 (191,8)	13.2 (335) 13.2 (335)	141.6 (64,2) 198.7 (90,1)
	PN 16 PN 40	9.8 (250) 12.2 (310)	7.55 (191,8) 7.55 (191,8)	13.2 (335) 13.2 (335)	109.4 (49,6) 156.5 (71,0)

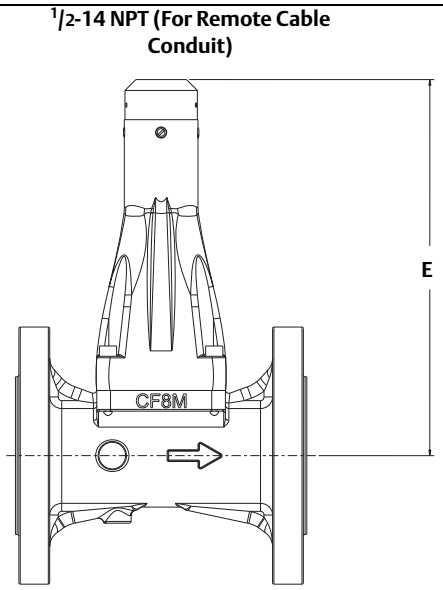
(1) Add 0.2 lb (0,1 kg) for display option.

Figure A-2. Dimensional Drawings for Remote Mount Transmitters



NOTE
Consult factory for SST installation
Dimensions are in inches (millimeters)

Figure A-3. Dimensional Drawings for Flanged Style Remote Mount Flowmeters (1-through 8-in./25 through 200 mm Line Sizes)



Flanged Flowmeter

NOTE
Dimensions are in inches (millimeters)

Table A-17. Remote Mount, Flanged Style Sensor Flowmeter Dimensions

Nominal Size in. (mm)	E Flange Style in. (mm)
1 (25)	6.5 (165)
1½ (40)	6.8 (173)
2 (50)	7.2 (183)
3 (80)	7.8 (198)
4 (100)	8.3 (211)
6 (150)	9.5 (241)
8 (200)	10.4 (264)

Appendix B Approval information

B.1 Product certifications

B.1.1 Approved manufacturing locations

Emerson Process Management Flow Technologies Company, Ltd - Nanjing, Jiangsu Province, P.R. China

⚠ WARNING

Transmitter enclosures with Flameproof Protection Type Ex d shall only be opened when power is removed.

The cable and conduit entry devices for protection type Ex d shall be of a certified Flameproof Protection Type Ex d, suitable for the conditions of use and correctly installed.

Closing of entries in the device must be carried out using the appropriate Ex n or Ex d cable gland and metal blanking plug or any appropriate ATEX or IECEx approved cable gland and blanking plug with IP66 rating. Unless otherwise marked on housing, the standard conduit entry thread forms are $^{1}/_{2}$-14 NPT.

Special conditions for safe use (X) are specified for each protection type [listed below].

B.1.2 International certifications (IECEx)

I.S. certification

IEC 60079-0: 2011 Edition: 6.0

IEC 60079-11: 2011-06 Edition: 6.0

I7 Certification No. IECEx BAS 12.0053X
Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ +70 °C)

Ui = 30 VDC
Ii = 185mA
Pi = 1.0W
Ci = 0µF
Li = 0.97mH

Special conditions for safe use (X)

1. When fitted with the 90V transient suppressors, the equipment is not capable of passing the 500V insulation test. This must be taken into account upon installation

2. The enclosure may be made from aluminum alloy with a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion when located in Zone 0.

3. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Type 'n' certification

IEC 60079-0: 2011 Edition: 6.0

IEC 60079-11: 2011-06 Edition: 6.0

IEC 60079-15: 2010 Edition: 4

N7 Certification No. IECEx BAS 12.0054X
Ex nA ic IIC T5 Gc (-40 °C ≤ Ta ≤ +70 °C)

Maximum Working Voltage = 42Vdc

Special conditions for safe use (X)

1. When fitted with the 90V transient suppressors, the equipment is not capable of passing the 500V insulation test. This must be taken into account upon installation.

2. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Flameproof certification

IEC 60079-0: 2011 Edition: 6

IEC 60079-1: 2007-04 Edition: 6

IEC 60079-11: 2011 Edition: 6

IEC 60079-26: 2006 Edition: 2

E7 Certification No. IECEx DEK 11.0022X
Integral Transmitter marked:
Ex d [ia Ga] IIC T6 Ga/Gb
Remote Transmitter marked:
Ex d [ia Ga] IIC T6 Gb
Remote Sensor marked:
Ex ia IIC T6 Ga

Ambient temperature range: -50 °C ≤ Ta ≤ 70 °C

Process temperature range: -202 °C to +427 °C

Power Supply: 42 Vdc Max.

Transmitter Um=250 V

Remote mounted sensor: in type of protection Ex ia IIC, only to be connected to the associated Model 8600D Vortex Flowmeter electronics.

The maximum length of the interconnecting cable is 152 m (500 ft).

Special conditions for safe use (X)

1. For information regarding the dimensions of the flameproof joints, the manufacturer shall be contacted.

2. The Flowmeter is provided with special fasteners of property class A2-70 or A4-70.

3. Units marked with "Warning: Electrostatic Charging Hazard" may use non- conductive paint thicker than 0.2 mm. Precautions shall be taken to avoid ignition due to electrostatic charge of the enclosure.

4. When the equipment is installed, precautions must be taken to ensure, taken into account the effect of the process fluid temperature, that the ambient temperature of the electrical parts of the equipment lies between -50 °C and +70°C.

B.1.3 Chinese certifications (NEPSI)

Flameproof certification

GB3836.1– 2010

GB3836.2– 2010

GB3836.4– 2010

E3 Certification No. GYJ111284X
Ex db ia IIC T6 (-50 °C ≤ Ta ≤ +70 °C)
Process temperature range: -202 °C to +427 °C
Power Supply: 42 Vdc Max.
Transmitter Um=250 V

Special conditions for safe use (X)

1. The maximum allowable length of the interconnecting cable between transmitter and sensor is 152m. The cable shall also be provided by Rosemount Inc., or by Emerson Process Management Co., Ltd., or by Emerson Process Management Flow Technologies., Ltd.
2. Suitable heat-resisting cables rated at least +80 °C shall be used when the temperature of the cable entry around exceed +60 °C.
3. Dimensions of flameproof joints are other than the relevant minimum or maximum specified in Table 3 of GB3836.2-2010. Please contact manufacturer for details.
4. The Flowmeter is provided with special fasteners of property class A2-70 or A4-70.
5. Any friction should be prevented in order to avoid the risk of electrostatic charge on the enclosure due to non-conductive paint.
6. The earthing terminal should be connected to the ground reliably at site.
7. Do not open when energized.
8. The cable entry holes have to be connected by means of suitable entry device or stopping plugs with type of protection of Ex db IIC, the cable entry device and stopping plugs are approved in accordance with GB3836.1-2010 and GB3836.2-2010, and which are covered by a separate examination certificate, any unused entry hole is to be fitted with type of protection of Ex db IIC flameproof stopping plug.
9. Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.
10. Precautions shall be taken to ensure that the electronic parts are within permissible ambient temperature considering the effect of the allowed fluid temperature.
11. During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13-1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”, GB3836.15-2000 “ Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)”, GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”, and GB50257-1996 “Code for construction and acceptance of electrical device for explosion atmospheres and fire hazard electrical equipment installation engineering”.

I.S. certification

GB3836.1– 2010

GB3836.4– 2010

GB3836.20– 2010

I3 Certification No. GYJ12.1239X
Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ +70 °C)

Ui = 30 Vdc

Ii = 185 mA

Pi = 1.0 W

Ci = 0uF

Li= 0.97mH

Special conditions for safe use (X)

1. The maximum allowable length of the interconnecting cable between transmitter and sensor is 152m. The cable shall also be provided by manufacturer.

2. When transient protection terminal block (The Other Option is T1) applied to this product, during installation, users shall comply with Clause 12.2.4 in GB3836.15-2000 "Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)."

3. Suitable heat-resisting cables rated at least +80 °C shall be used when the temperature of the cable entry around exceed +60 °C.

4. Only be connected to the certified associated apparatus, the Vortex Flowmeter could be used in the explosive atmosphere. The connection should be complied with the requirements of the manual of the associated apparatus and the Vortex Flowmeter.

5. The enclosure should be taken to protect it from impact.

6. Any friction should be prevented in order to avoid the risk of electrostatic charge on the enclosure due to non-conductive paint.

7. The cable with shield is suitable for connection, and the shield should be connected to earth.

8. The enclosure shall be kept from the dust, but the dust shall not be blown by compressed air.

9. The cable entry holes have to be connected by means of suitable cable entry, the way of being installed shall be ensure that the equipment satisfies degree of protection IP66 according to GB4208-2008.

10. Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.

11. Precautions shall be taken to ensure that the electronic parts are within permissible ambient temperature considering the effect of the allowed fluid temperature.

12. During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13-1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”, GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)”, GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”, and GB50257-1996 “Code for construction and acceptance of electrical device for explosion atmospheres and fire hazard electrical equipment installation engineering”.

Type ‘n’ certification

N3 Certification No. GYJ12.1240X
Ex nA ic IIC T5 Gc (-40 °C ≤ Ta ≤ +70 °C)
Maximum working voltage 42 Vdc

Special conditions for safe use (X)

1. The maximum allowable length of the interconnecting cable between transmitter and sensor is 152m. The cable shall also be provided by the manufacturer.

2. Suitable heat-resisting cables rated at least +80°C shall be used when the temperature of the cable entry around exceed +60°C.

3. When transient protection terminal block (The Other Option is T1) applied to this product, during installation, users shall comply with Clause 12.2.4 in GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines).”

4. Any friction should be prevented in order to avoid the risk of electrostatic charge on the enclosure due to non-conductive paint.

5. Do not open when energized.

6. The cable entry holes have to be connected by means of suitable cable entry, the way of being installed shall be ensure that the equipment satisfies degree of protection IP54 according to GB4208-2008.

7. Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.

8. Precautions shall be taken to ensure that the electronic parts are within permissible ambient temperature considering the effect of the allowed fluid temperature.

9. During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13-1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”, GB3836.15-2000 “ Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)”, GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”, and GB50257-1996 “Code for construction and acceptance of electrical device for explosion atmospheres and fire hazard electrical equipment installation engineering”.

B.1.4 European certifications (ATEX)

I.S. certification

EN 60079-0: 2012

EN 60079-11: 2012

I1 Certification No. Baseefa12ATEX0179X
ATEX Marking II 1 G
Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ +70 °C)
Ui = 30 VDC
Ii= 185 mA
Pi = 1.0 W
Ci = 0uF
Li = 0.97 mH

Special conditions for safe use (X)

1. When fitted with 90V transient suppressors, the equipment is not capable of passing the 500V isolation test. This must be taken into account upon installation.

2. The enclosure may be made from aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion when located in Zone 0.

3. When the equipment is installed, particular precautions must be taken to ensure taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Type 'n' certification

EN 60079-0: 2012

EN 60079-11: 2012

EN 60079-15: 2010

N1 Certification No. Baseefa12ATEX0180X
ATEX Marking II 3 G
Ex nA ic IIC T5 Gc (-40 °C ≤ Ta ≤ +70 °C)
Maximum Working Voltage = 42 Vdc

Special conditions for safe use (X)

1. When fitted with 90V transient suppressors, the equipment is not capable of passing the 500V isolation test. This must be taken into account upon installation.

2. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Flameproof certification

EN 60079-0: 2009

EN 60079-1: 2007

EN 60079-11: 2007

60079-26: 2007

E1 Certification No. DEKRA12ATEX0189X
Integral Transmitter marked:
ATEX Marking II 1/2 G
Ex d [ia Ga] IIC T6 Ga/Gb
Remote Transmitter marked:
ATEX Marking II 2 G
Ex d [ia Ga] IIC T6 Gb
Remote Sensor marked:
ATEX Marking II 1 G
Ex ia IIC T6 Ga

Ambient temperature range: -50 °C ≤ Ta ≤ +70 °C
Process temperature range: -202 °C to +427 °C
Maximum Working Voltage = 42 Vdc
Transmitter Um = 250V

Remote mounted sensor: in type of protection Ex ia IIC, only to be connected to the associated Model 8600D Vortex Flow meter electronics.

The maximum allowable length of the interconnecting cable is 152m (500ft.)

Special conditions for safe use (X)

1. For information regarding the dimensions of the flameproof joints the manufacturer shall be contacted.

2. The Flowmeter shall be provided with special fasteners of property class A2-70 or A4-70.

3. Units marked with “Warning: Electrostatic Charging Hazard” may use non-conductive paint thicker than 0.2 mm. Precautions shall be taken to avoid ignition due to electrostatic charge on the enclosure.

Dust certification

EN 60079-0: 2009

EN 60079-11: 2007

EN 60079-31: 2009

ND Certification No. DEKRA12ATEX0190X
Integral Transmitter marked:
ATEX Marking II 1 D
Ex ta [ia] IIIC T500 90°C Da
Remote Transmitter marked:
ATEX Marking II 1 D
Ex ta [ia] IIIC T500 90°C Da
Remote Sensor marked:
ATEX Marking II 1 D
Ex ia IIIC T500 90°C Da

Ambient temperature range: -50 °C ≤ Ta ≤ +70 °C
Process temperature range: -202 °C to +427 °C
Maximum Working Voltage = 42 Vdc
Transmitter Um=250 V

Remote mounted sensor: in type of protection Ex ia IIIC, only to be connected to the associated Model 8600D Vortex Flow meter electronics.
The maximum allowable length of the interconnecting cable is 152m (500ft.)

Special conditions for safe use (X)

Units marked with “Warning: Electrostatic Charging Hazard” may use non-conductive paint thicker than 0.2 mm. Precautions shall be taken to avoid ignition due to electrostatic charge on the enclosure.

Appendix C Electronics verification

Safety messages ..... page 119
Electronics verification ..... page 120
Examples ..... page 125

Electronics verification of the Model 8600D can be done by either utilizing the internal signal simulation capability or by applying an external signal source to the “TEST FREQ IN” and “GROUND” pins.

C.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please
refer to the following safety messages before performing any operation in this section.

⚠ WARNING

Explosions could result in death or serious injury:

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

⚠ CAUTION

Remove power before removing the electronics housing.

C.2 Electronics verification

Electronics functionality can be verified via two different verification methods:

- Flow Simulation Mode
- Using an External Frequency Generator

Both methods require the use of a Field Communicator or AMS. It is not required to disconnect the sensor to perform the electronics verification since the transmitter is capable of disconnecting the sensor signal at the input to the electronics. Should the user choose to physically disconnect the sensor from the electronics, refer to Replacing the electronics housing on page 79.

C.2.1 Electronics verification using flow simulation mode

Field Comm.	1, 2, 4, 3, 1

Electronics verification can be done by utilizing the internal flow simulation functionality. This functionality is available as model option code DS1 at the time of order. The Rosemount 8600D is capable of simulating either a fixed flow rate or a varying flow rate. The amplitude of the simulated flow signal is based on the minimum required process density for the given line size and service type. Either type of simulation (fixed or varying) will effectively disconnect the Rosemount 8600D sensor from the electronics charge amplifier input (see Figure 5-2 on page 72) and replace it with the simulated flow signal.

C.2.2 Fixed flow rate simulation

Field Comm.	1, 2, 4, 3, 1, 1

The fixed flow simulation signal can be entered in either percent of range or flow rate in the current engineering units. The resulting flow rate and/or shedding frequency can be continuously monitored via a Field Communicator or AMS.

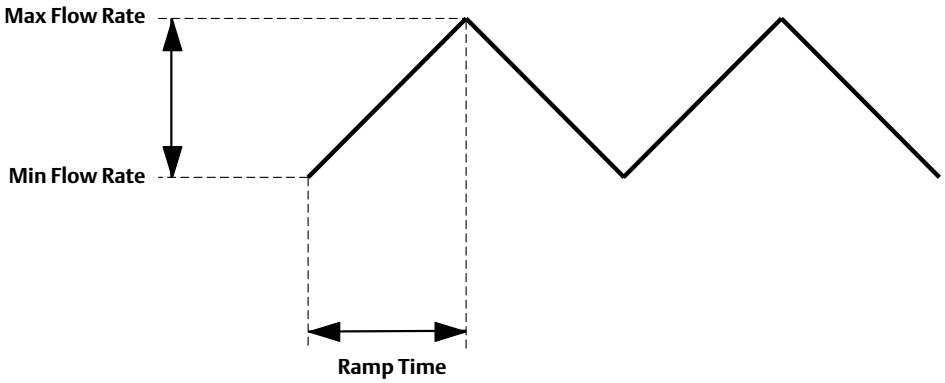
C.2.3 Varying flow rate simulation

Field Comm.	1, 2, 4, 3, 1, 2

The profile of the varying flow simulation signal is a repetitive triangular waveform as illustrated in Figure C-1. The minimum and maximum flowrate can be entered in either percent of range or entered as a flow rate in the current engineering units. The ramp time can be entered in seconds from a minimum of 0.6 seconds to a maximum of 34951 seconds. The resulting flow rate and/or shedding frequency can be continuously monitored via a Field Communicator or AMS.

Note
To manually disconnect the sensor for precautionary measures, see Replacing the electronics housing on page 79 for details.

Figure C-1. Profile of Varying Flow Simulation Signal.



C.2.4 Electronics verification using an external frequency generator

If an external frequency source is desirable, then test points on the electronics are available (see Figure C-2).

Tools needed

- Field Communicator or AMS
- Standard sinewave function generator

1. Remove the electronics compartment cover.
2. Remove the two screws and the LCD indicator if applicable.
3. Connect a Field Communicator or AMS to the loop.

Field Comm.	1, 2, 4, 3, 2

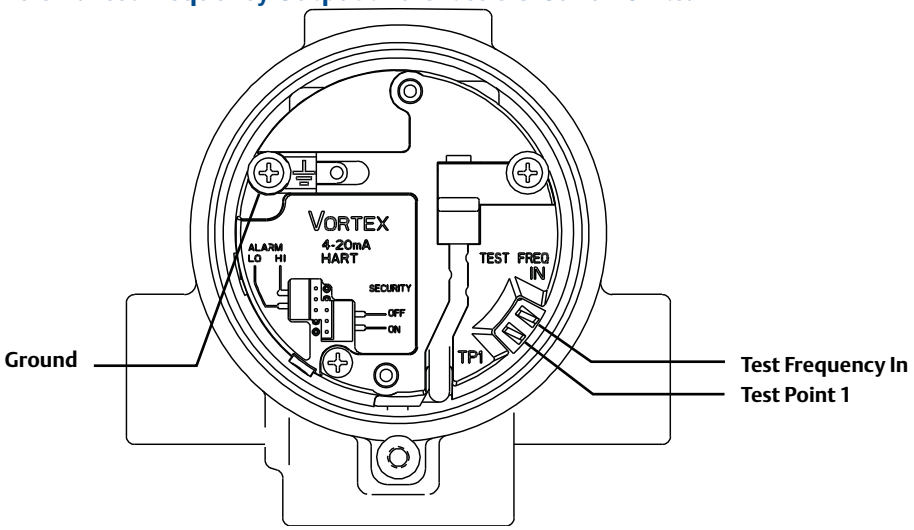
4. Access the flow simulation menu on the communicator and select “Sim Flow External.” This item is used with an External Frequency Generator. This will effectively disconnect the Rosemount 8600D sensor input from the charge amplifier input of the electronics (see Figure 5-2 on page 72). The simulated flow and/or the shedding frequency values will now be accessible via the Field Communicator or AMS.
5. Connect the sinewave generator to the “TEST FREQ IN” and “GROUND” points as shown in Figure C-2.
6. Set the sinewave generator amplitude to 2Vpp±10%.
7. Select the desired sinewave generator frequency.
8. Verify the generator frequency against the frequency displayed on the Field Communicator or AMS.

Field Comm.	1, 2, 4, 4

9. Exit the Flow Simulation Mode.
10. Reconnect the LCD indicator option (if applicable) to the electronics board by replacing and tightening the two screws.
11. Replace and tighten the electronics compartment cover.

Note
To manually disconnect the sensor for precautionary measures, see Replacing the electronics housing on page 79 for details.

Figure C-2. Test Frequency Output and Chassis Ground Points.



C.2.5 Calculating output variables with known input frequency

Use the following equations with a known input frequency for verification of a flow rate or 4–20 mA output within a given calibrated range. Select the proper equation depending on if you are verifying a flow rate, mass flow rate, 4–20 mA output, or special units. Example calculations starting on page 125 may clarify how these equations are used.

To verify a flow rate

For a given frequency F (Hz), and K-factor (compensated), find the flow rate Q:

$$Q = F(Hz) / (K \times C_X)$$

where C_x is the unit conversion (Table C-1 on page C-125).

To verify a standard or normal flow rate

$$Q = F(Hz) \times ((DensityRatio) / (K \times C_X))$$

To verify a mass flow rate

For a given mass frequency F (Hz), and K-factor (compensated), find the mass flow rate M:

$$M = \frac{F}{(K/\rho) \cdot C}$$

where C is the unit conversion and ρ is density at operating conditions:

$$M = F(Hz) / (KC_X)$$

where C_x is the unit conversion using density (ρ) (Table C-1 on page C-125).

To verify a 4–20 mA output

For a given input frequency F (Hz), and K-factor (compensated), find output current I:

$$I = \left(\left[\frac{(F(Hz) / K \times C_X) - LRV}{URV - LRV} \right] (16) \right) + 4$$

where C_x is the unit conversion (Table C-1 on page C-125), URV is the upper range value (user units), and LRV is the lower range value (user units).

To verify a special units output

For special units, first divide the special unit-conversion factor into the base unit factor C_x.

$C_{20} = C_x$/sp. units conv. factor (Table C-1 on page C-125).

Unit conversion table (user units to GPS)

Use the following table to assist with calculated frequencies when using user defined units.

Table C-1. Unit Conversions

C_x	Units (act)	Conversion Factor
C_1	gal/s	1.00000E+00
C_2	gal/m	1.66667E-02
C_3	gal/h	2.77778E-04
C_4	Impgal/s	1.20095E+00
C_5	Impgal/m	2.00158E-02
C_6	Impgal/h	3.33597E-04
C_7	L/s	2.64172E-01
C_8	L/m	4.40287E-03
C_9	L/h	7.33811E-05
C_{10}	CuMtr/m	4.40287E-00
C_{11}	CuMtr/h	7.33811E-02
C_{12}	CuFt/m	1.24675E-01
C_{13}	CuFt/h	2.07792E-03
C_{14}	bbl/h	1.16667E-02
C_{15}	kg/s	$C_{10}{}^{*}60/\rho$
C_{16}	kg/h	C_{11}/ρ
C_{17}	lb/h	C_{13}/ρ
C_{18}	shTon/h	$C_{17}\times 2000$
C_{19}	mTon/h	$C_{16}\times 1000$
C_{20}	SPECIAL	C^{*}_{x}/ρ

r=*operating density*
* *Special Units Conversion Factor*

C.3 Examples

The following examples illustrate the flowrate calculations that may be necessary for your application. There are water, saturated steam, and natural gas applications represented in the examples. The first set of three examples is in English units. The second set of three examples is in SI units.

C.3.1 English units

Example 1 (English units)

Fluid = Water

Line size = 3 in.

Line pressure= 100 psig

Vortex Frequency = 75 Hz

URV= 500 gpm

LRV= 0 gpm

C_2 = 1.66667E-02 (from Table C-1 on page C-125)

K-factor (compensated) = 10.79 (via Field Communicator or AMS)

$$Q = F(Hz)/(K \times C_2)$$

= 75.00/(10.79 × 0.0166667)

= 417.1 gpm

Therefore, an input frequency of 75.00 Hz represents a flow rate of 417.1 gpm in this application.

For a given input frequency, you may also determine the current output. Use the above example with an input frequency of 75.00 Hz:

URV= 500 gpm LRV= 0 gpm F_{in} = 75.00 Hz

$$I = \left(\left[\frac{F(Hz)/(K \times C_2) - LRV}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{75.00/(10.79 \times 0.0166667) - 0}{500 - 0} \right] \times (16) \right) + 4$$

= 17.35 mA

Therefore, an input frequency of 75.00 Hz represents a current output of 17.35 mA.

Example 2 (English units)

Fluid	= Saturated Steam	URV	= 40000 lb/hr
Line size	= 3 in.	LRV	= 0 lb/hr
Line pressure	= 500 psia	C_{17}	= C_{13}/ρ (Table C-1 on page C-125)
Operating Temperature	= 467 °F	Density (ρ)	= 1.078 lb/cu-ft
Viscosity	= 0.017 cp	Vortex Frequency	= 400 Hz
K-factor (compensated)	= 10.678 (via Field Communicator or AMS)		
M	= F(Hz) /(K x C_{17})		
	= 400/ {10.678 x (C_{13}/ρ)}		
	= 400/{10.678 x (0.00207792/1.078)}		
	= 400/(10.678 x 0.0019276)		
	= 19433.6 lb/hr		

Therefore, an input frequency of 400 Hz represents a flow rate of 19433.6 lb/hr in this application.

For a given input frequency, you may also determine the current output. Use the Example 2 on page 126 with an input frequency of 300 Hz:

URV= 40000 lb/hr LRV= 0 lb/hr F_{in}(Hz) = 300.00

$$I = \left(\left[\frac{F(Hz)/(K \times C_{17}) - LRV}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{300/((10.678 \times 0.0019276) - 0)}{40000 - 0} \right] \times (16) \right) + 4$$

= 9.83 mA

Therefore, an input frequency of 300.00 Hz represents a current output of 9.83 mA.

Example 3 (English units)

Fluid	= Natural gas	URV	= 5833 SCFM
Line size	= 3 in.	LRV	= 0 SCFM
Line pressure	= 140 psig	C_{20}	= C_x/sp. units factor (from Table C-1 on page C-125)
Operating Temperature	= 50 °F	Density (ρ)	= 0.549 lb/cu-ft (oper)
Viscosity	= 0.01 cp	Input Frequency	= 700 Hz
K-factor (compensated)	= 10.678 (via Field Communicator or AMS)		
Q	= F(Hz) /(K x C_{20}) where: C_{20} = C_{12}/10.71 (Density Ratio)		
	= 700/{10.797 x (0.124675/10.71)}		
	= 5569.4 SCFM		

Therefore, an input frequency of 700.00 Hz represents a flow rate of 5569.4 SCFM in this application.

For a given input frequency, you may also determine the current output. Use the above example with an input frequency of 200 Hz.

URV= 5833 SCFM LRV= 0 SCFM F_{in} (Hz) = 200.00

$$I = \left(\left[\frac{F(Hz)/(K \times C_{20}) - LRV}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{200/((10.797 \times 0.011641) - 0)}{5833 - 0} \right] \times (16) \right) + 4$$

= 8.36 mA

Therefore, an input frequency of 200 Hz represents a current output of 8.36 mA.

C.3.2 SI units

Example 1 (SI units)

Fluid	= Water	URV	= 2000 lpm
Line size	= 80 mm.	LRV	= 0 lpm
Line pressure	= 700 kPas	C_8	= 4.40287E-03 (from Table C-1 on page C-125)
Operating Temperature	= 60 °F		
Input Frequency	= 80 Hz		
K-factor (compensated)	= 10.772 (via Field Communicator or AMS)		
M	= F(Hz) /(K x C_8)		
	= 80/(10.722 x 0.00440287)		
	= 1694.6 lpm		

Therefore, an input frequency of 80.00 Hz represents a flow rate of 1694.6 lpm in this application.

For a given input frequency, you may also determine the current output. Use the above example with an input frequency of 80.00 Hz:

URV= 2000 lpm LRV= 0 lpm F_{in} (Hz) = 80.00

$$I = \left(\left[\frac{F(Hz)/(K \times C_8) - LRV}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{80/((10.772 \times 0.00440287) - 0)}{2000 - 0} \right] \times (16) \right) + 4$$

= 17.49 mA

Therefore, an input frequency of 80.00 Hz represents a current output of 17.49 mA.

Example 2 (SI units)

Fluid	= Saturated Steam	URV	= 3600 kg/hr
Line size	= 80 mm.	LRV	= 0 kg/hr
Line pressure	= 700 kPas	C_{16}	= C_{11}/ρ (from Table C-1 on page C-125)
Operating Temperature	= 170 °F	Density(ρ)	= 4.169 kg/cu-mtr (operating)
Viscosity	= 0.015 cp		
Input Frequency	= 650 Hz		
K-factor (compensated)	= 10.715 (via Field Communicator or AMS)		
M	= F(Hz) /(K x C_{16})		
	= 650/{10.715 x (C_{11}/ρ)}		
	= 650/{10.715 x (0.0733811/4.169)}		
	= 650/(10.715 x 0.017602)		
	= 3446.4 kg/hr		

Therefore, an input frequency of 650.00 Hz represents a flow rate of 3446.4 kg/hr in this application.

For a given input frequency, you may also determine the current output. Use the prior example with an input frequency of 275 Hz:

URV= 3600 kg/hr LRV= 0 kg/hr F_{in}(Hz) = 275

$$I = \left(\left[\frac{F(Hz)/K \times C_{16} - LRV}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{275/((10.715 \times 0.017602) - 0)}{3600 - 0} \right] \times (16) \right) + 4$$

= 10.48 mA

Therefore, an input frequency of 275.00 Hz represents an output current of 10.48 mA.

Example 3 (SI units)

Fluid	= Natural gas	URV	= 10,000 NCMH
Line size	= 80 mm	LRV	= 0 NCMH
Line pressure	= 1000 KPas	C_{20}	= C_x/sp. units factor (from Table C-1 on page C-125)
Operating Temperature	= 10 °F	Density (ρ)	= 9.07754 kg/cu-mtr (operating)
Viscosity	= 0.01 cp		
Input Frequency	= 700 Hz		
K-factor (compensated)	= 10.797 (via Field Communicator or AMS)		
Q	= F(Hz) /(K x C_{20}) where: C_{20} = C_{11}/10.48 (Density Ratio)		
	= 700/{10.797 x (.0733811/10.48)}		
	= 9259.2 NCMH		

Therefore, an input frequency of 700.00 Hz represents a flow rate of 9259.2 NCMH in this application.

For a given input frequency, you may also determine the current output. Use the prior example with an input frequency of 375 Hz.

URV= 10000 NCMH LRV= 0 NCMH F_{in}(Hz) = 375.00

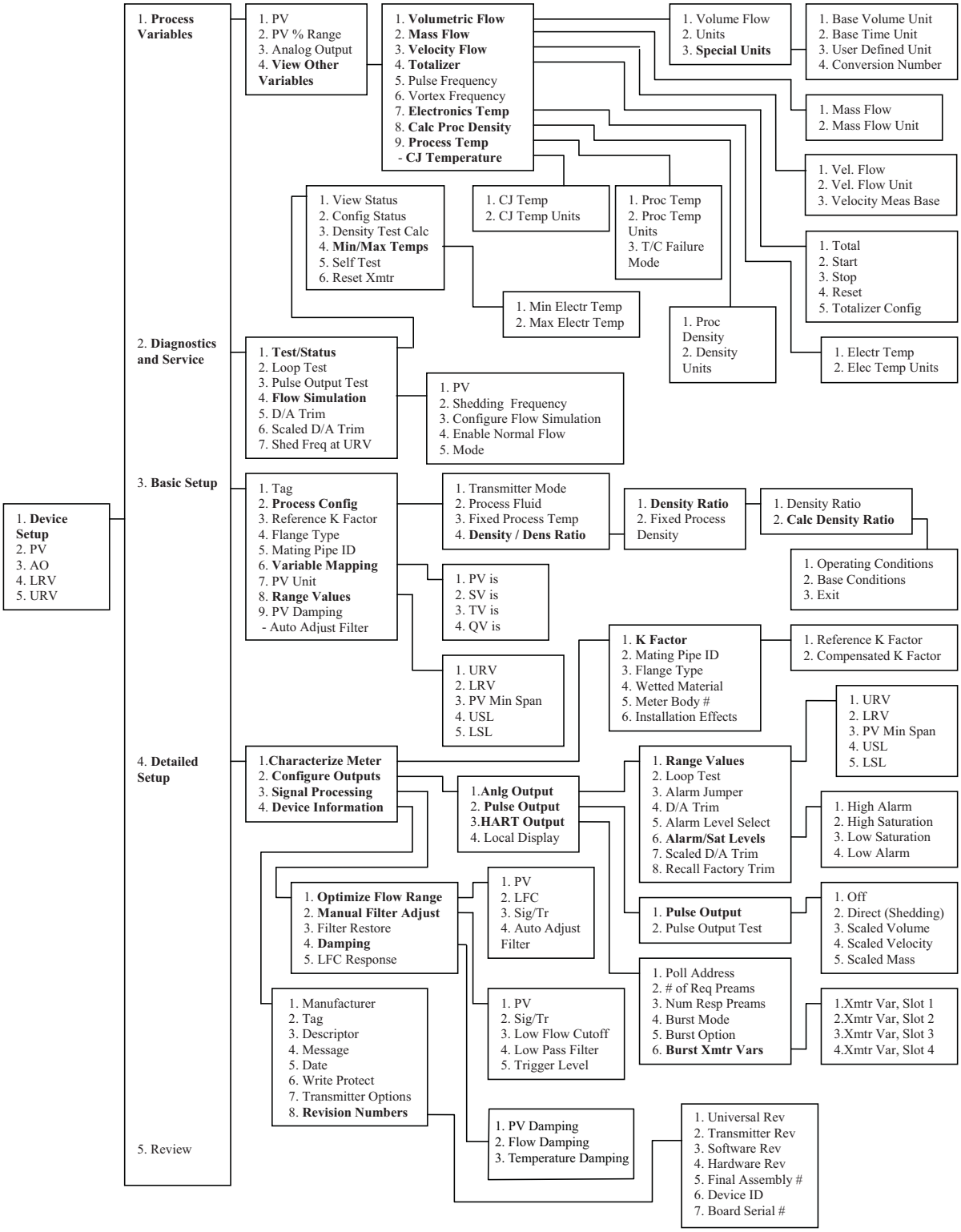
$$I = \left(\left[\frac{F(Hz)/(K \times C_{20}) - LRV}{URV - LRV}\right] \times (16)\right) + 4$$

$$I = \left(\left[\frac{375/((10.797 \times 0.0070020) - 0)}{10000 - 0}\right] \times (16)\right) + 4$$

= 11.94 mA

Therefore, an input frequency of 375.00 Hz represents a current output of 11.94 mA.

Figure 1-1. Rosemount 8600D HART™ Menu Tree



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